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E. F. Stratton Reader.

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To his valued friend
J Lindsay Eyre
Dover

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AN ESSAY ON THE STRUCTURE AND FORMATION OF THE TEETH IN MAN AND VARIOUS ANIMALS,

ILLUSTRATED WITH COPPER-PLATES.

BY

ROBERT BLAKE, M. D.

BEING PRINCIPALLY A TRANSLATION OF HIS INAUGURAL DISSERTATION, PUBLISHED AT EDINBURGH SEPTEMBER 1798.

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WHOSE EFFORTS

IN THE

IMPROVEMENT OF NATURAL KNOWLEDGE

HAVE

" FOR THE ADVANTAGE OF MANKIND"

BEEN ASSIDUOUSLY AND SUCCESSFULLY EXERTED,

THIS ESSAY

IS GRATEFULLY AND AFFECTIONATELY

INSCRIBED BY

ROBERT BLAKE.

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ERRATA.

Page 28 line 19 for dililigentia read diligentia.
—— 30 — 19 — yen — y'en.
—— — 32 — after dentiſte add Tom. I.
—— 32 — 13 — Euſtachlus — Euſtachius
—— 59 — 21 — faor — fateor
—— 84 — 28 — dele. con. from conſolidated.
—— 97 — 18 — protuded — protruded
—— 120 — remove * from line 5 to line 6 after obſerves.
~~—— 157 —— 11 —— power —— powder.~~
—— 162 — 22 — membrance — membrane.
—— 185 — 16 — dele the.
—— 201 — 5 — after tooth add (
—— 209 — 13 — and — of.

A few others of ſlight moment are left to the indulgence of the reader.

ADVERTISEMENT.

AGREEABLE to the laws of the univerſity of Edinburgh, my theſis was preſented to one of its profeſſors in June 1798, three months previous to my graduation. Moſt of the anatomical preparations (drawings of which are annexed to the work) were made in Dublin in the year 1795, and the inferences deduced from them were communicated ſoon after to ſeveral gentlemen both in London and Edinburgh.

The favourable reception my theſis met with, from ſome of the higheſt literary characters, induced me, on my return to this country, to promiſe an immediate tranſlation; but anxious to ſee ſome preparations in London, references to which I thought would more clearly elucidate ſome principles I wiſhed fully to eſtabliſh, and not having it in my power to viſit that capital until September 1799, I thought better to defer its publication.

However,

However, the additions made, I truſt, will in ſome meaſure apologiſe for its delay, and I hope it will now be found worthy the attention and indulgence of the public. In order to render this eſſay more generally underſtood, the quotations are tranſlated as literally as poſſible, and although the original plan has been followed with little deviation, yet ſuch alterations have been occaſionally made as it appeared would be either uſeful or intereſting.

INTRODUCTION.

INTRODUCTION.

TO man, as his excluſive privilege, has the inveſtigation of her works been allotted by Nature. From this purſuit does he derive the trueſt ſource of mental happineſs: With admiration he beholds, with rapture he traces her, through her myſterious paths, at once delighted and aſtoniſhed at thoſe admirable contrivances, by which ſhe conducts her various operations. Nor has this ſpirit of inquiry been limited to any age or people; ſlow yet certain in its progreſs, it has with unerring pace purſued its grand deſign. Hence innumerable advantages have from time to time accrued to ſociety: to this principle has the cultivation of philoſophy in general been indebted; and thus has that diviſion of it, more immediately connected with the preſervation of our own ſpecies, been reſcued from the hands of empirics, to be placed high amongſt the other branches of ſcience.

I need ſcarcely obſerve that this great progreſs in medicine, has been, as in other ſciences, owing to an accurate and ſedulous attention to its principles; I mean anatomy and chemiſtry, as well as the laws of the animal œconomy. Yet numerous and rapid as have been the different improvements and diſcoveries made in the various branches of theſe ſciences ſince the year 1700, little has been done in that department, which I have ſelected for the ſubject of the following eſſay, ſince the year 1563, when Euſtachius publiſhed the firſt edition of his *Opuſculum de Dentibus*. From that period however, diſeaſes of the teeth began to attract attention, and a few valuable works were written on that ſubject.

Amongſt the firſt of theſe is a work publiſhed by *Urbain Hemard**, an ingenious French ſurgeon. Some others appeared nearly about the ſame time, as alſo in the courſe of the ſixteenth century, to notice which, the limits of this eſſay would ſcarcely allow me; indeed I conſider any reference to them at preſent unneceſſary. About the year 1700, the neceſſity of ſome artificial mode of preſerving the teeth attracted particular attention in Paris, and a few ſurgeons there, began to confine their operations to diſeaſes of the mouth and teeth alone; from which period may be dated the commencement of uſeful knowledge in that branch, founded on experience. Of thoſe works publiſhed on the Continent the beſt is that by *Fauchard**. Though a very ingenious and uſeful eſſay appeared afterwards on the ſame ſubject, by *Bourdet* †, this I had not an opportunity of peruſing until ſome time after my theſis had been printed. The only treatiſe of conſequence which has appeared in our language is by the celebrated Mr. John Hunter, under the title of the Natural Hiſtory of the Human Teeth ‡. This contains ſome ingenious and valuable obſervations; but as many of them were collected from dentiſts of his acquaintance, and as Mr. Hunter did not confine his operations to that part of medical ſurgery in queſtion, I ſhould be leſs inclined to place implicit confidence in his opinions, reſpecting a branch, which, though limited, yet requires the moſt minute attention, and unremitting inveſtigation.

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* *Recherche de la vraie Anatomie des dents, nature et proprietez d'icelles, avec les maladies qui leur adviennent.* Publiſhed at Lyons, 1582.

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* Le Chirurgien Dentiſte, publiſhed at Paris about the year 1740.

† De l'art du Dentiſte, Paris 1757.

‡ Publiſhed at London 1771.

On comparing theſe works with thoſe of anatomiſts in general, I found innumerable points by no means cleared up, and by the advice of the celebrated Dr. Rutherford of Edinburgh; I applied cloſely, ſome years to this branch of anatomy, with a view to aſcertain the ſtructure and formation of the teeth. During theſe reſearches, many circumſtances occurred, which, as far as I have been able to learn, had been hitherto altogether overlooked; and which ſeemed to me of the greateſt importance in the management of the teeth and gums, particularly thoſe of children. I therefore thought it more adviſable, at once to ſubmit my ideas on this ſubject, to the conſideration of the public, even with all their imperfections, than delay them to a future period. It is my intention however to treat of the diſeaſes incident to the teeth and gums, more fully hereafter.

To be more readily underſtood, I have annexed plates, repreſenting thoſe preparations which I thought moſt eſſential; ſome of them were not recent, owing to the very great difficulty of procuring ſubjects which had died, at the preciſe period when the gradations would have been particularly conſpicuous; of courſe the engravings from theſe cannot be expected to convey as perfect ideas of them, as could have been wiſhed. Some of the engravings are larger, others ſomewhat ſmaller than the preparations they repreſent; this neceſſarily happens where compaſſes cannot be uſed: for the moſt part, however, they are accurate.

As I intend in a great meaſure to confine my obſervations in the following eſſay, to the teeth and gums, I muſt refer thoſe who wiſh for a more particular deſcription of the jaws, to works written on *Oſteogeny* and *Oſteology* *. It is however neceſſary to mention, that in general about two months after conception, oſſification commences in the membranes and cartilages of the jaws. For example, the under jaw is at firſt compoſed of two pieces connected by ligaments at the middle of the chin. The baſe of each piece, is the part which begins to oſſify; then the ſides, which are in general called alveolar proceſſes, undergo a progreſſive change of conſiſtence. They are formed of two laminæ, an external one next the cheek, and an internal one next the tongue; ſo that a groove is formed by theſe proceſſes, in which are contained the veſſels, nerves, and ſeveral little ſoft pulpy ſubſtances, all of which are ſeparated from each other by proper membranes. As oſſification advances, bony fibres ſhoot acroſs from contrary ſides of the proceſſes, forming an encloſure round each pulp, the circumference of which is commonly called a ſocket, and as ſome teeth have ſeveral roots, a diſtinct ſocket is formed round each root.

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* Albinus, oſſium fætus humani; Munro, Neſbitt, Havre, &c.

In children a certain number of teeth are formed, which being intended to laſt for only a limited time, they then gradually looſen, fall out, and are ſucceeded by as many new ones, ſome of them fall about the ſixth or ſeventh year, while others remain until the tenth, twelfth, or even the fourteenth year. The neceſſity for ſhedding the infantile teeth will appear ſufficiently obvious, when we conſider that larger teeth in general are neceſſary for the purpoſes of an adult, than for thoſe of a child; ſo that nature found it an eaſier proceſs to form new ones, than extend or enlarge the old, which indeed from their particular ſtructure could not be effected. When the parts have arrived at ſuch degree of extent, as to allow teeth to be formed ſufficiently large, the teeth ſo formed are never ſhed; ſuch are the adult or Permanent grinders. It is to be underſtood however, that theſe obſervations relate to man, or quadrupeds, whoſe teeth reſemble thoſe of man; for in other animals a remarkable difference occurs, as ſhall afterwards be particularly noticed.

The annual change of the ſhell of the lobſter, and many other ſpecies of ſhell fiſh, may be explained on ſimilar principles; for their ſhells are formed nearly in like manner with the teeth, and of courſe they cannot extend; ſo that when the body of the animal is about to increaſe, the ſhell opens in a particular place, allows the ſoft parts to get out, and in ſome ſhort time after, a new ſhell is formed over them.

The firſt teeth according to the celebrated Albinus, I have called Deciduous; but will now make uſe of the word Temporary in preference, that being the term in moſt general uſe; theſe teeth are twenty in number, and are divided by Mr. Hunter into three claſſes, called, *Inciſores*, *Cuſpidati* and *Molares*, or Grinders. There are in each jaw, four *Inciſores*, two *Cuſpidati*, or thoſe commonly called eye-teeth, and four *Grinders*.

The teeth which ſucceed them, and the intire of the adult ſet, I have called Immutable, though Albinus confines this term to the grinders of the adult, which, as I ſaid before are not ſhed; the word Permanent, however, I intend to ſubſtitute for it. Theſe teeth are thirty-two in number, and are properly divided by Mr. Hunter into four claſſes; in each jaw, there are four *Inciſores*, two *Cuſpidati*, four *Bicuſpides*, or the two at each ſide immediately next the *Cuſpidati*, and ſix *Grinders*.

As almoſt every name which has been hitherto made uſe of to expreſs that hard and poliſhed ſubſtance, with which the body of a tooth is covered externally, ſuppoſes it to be of a vitreous nature, than which nothing can be more erroneous; I have taken the liberty to call it the *Cortex Striatus*, as ſuch an appellation ſeems to coincide more with the nature of it.

It is ſcarcely neceſſary to obſerve, that each tooth is divided into three portions; the body or that part which appears above the gum; the neck or termination of the Cortex Striatus on the bony part; and the root.

AN

ESSAY,

&c. &c.

CHAPTER I.

Of the Rudiments of the Temporary teeth.

ON examining the jaws of a fœtus, about the fourth month after conception, I obſerved the rudiments or vaſcular membranes of twelve teeth in each jaw; ſcil. thoſe of all the temporary teeth, and alſo thoſe of the anterior permanent grinders. Theſe membranes or ſacs were even at this period ſufficiently apparent, and ſo intimately connected with the internal part of the gum, that they ſeemed derived from it, and came away with it, when torn from the groove in the jaw, leaving behind the veſſels, nerves, &c. with which they had been in contact. At this period there was ſcarcely any appearance of the bony fibres, ſhooting acroſs from the alveolar proceſſes, to form ſockets; except thoſe intended for the Inciſores.

The veſſels which enter the lower part of theſe ſacs, depoſit in them a ſubſtance, exactly ſimilar to jelly in conſiſtence and tranſparency; upon this the bony part of the tooth is formed; it becomes very vaſcular, and aſſumes nearly the ſhape and ſize, which the upper part of the tooth is to have, after the oſſification of it has commenced. This ſubſtance is commonly called the pulp; on ſome of them I obſerved elaſtic bony ſhells already formed in the fœtus I have juſt mentioned *.

In the left ſide of the under jaw of a fœtus, about the fifth month, (the internal part of the alveolar proceſs being cut away), the con-

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* Tab. i. Fig. 1.

nexion of the veſſels with the ſacs appeared as they are repreſented in Tab. i. Fig. 2. The preparation from which this figure was taken, had been dried and afterwards preſerved in ſpirits of turpentine, ſo that the membranes, &c. appear very much contracted. But in Tab. v. Fig. 1. the right ſide of the recent under jaw of a fœtus calf, with the connexion of the gum, veſſels, &c. are accurately repreſented.

In a fœtus between the eighth and ninth month, oſſification had commenced on all the pulps, and at one point, even on the pulp of each of the anterior permanent grinders*. The rudiments were all of them nearly ſeparated by bony partitions, except thoſe of the poſterior temporary and anterior permanent grinders, which were ſtill contained in the ſame ſocket †.

In children at birth, I have generally found the ſhells ſomewhat more advanced, and all the points of oſſification nearly united on the pulps of the temporary grinders.

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* Tab. i. Fig. 3. l.

† Tab. iii. Fig. 2. d. d.

The ſacs or membranes which ſurround the ſhells, are thickeſt and moſt denſe next the gum; but become by degrees ſofter and more gelatinous towards the lower part. They can be eaſily ſeparated into two lamellæ, the external of which is ſpongy and full of veſſels. The internal one is more tender and delicate, and ſeems to contain no veſſels capable of conveying red blood, at leaſt I could not diſcover any ſuch, even though aſſiſted by a very ſubtile injection. Theſe experiments I have repeatedly made, on the membranes of premature calves, with the ſame ſucceſs *. The celebrated Mr. John Hunter however aſſerts the very reverſe, for he ſays †, "The external is ſoft "and ſpongy, without any veſſels; the other "is much firmer, and extremely vaſcular." The internal part of theſe ſacs, ſoon after the commencement of the bony ſhells, depoſits on their points and ſides a ſoft earthy matter,

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* Tab. v. Fig. 6. b. b. † Nat. Hiſt. of the Human Teeth, p. 87.

moiſtened with a mucilaginous fluid ; a ſmall quantity of which is found between the membranes and ſhells. This earthy matter I found even at birth ſo ſoft, that it could be ſcraped off with the nail of the finger. It may be proper to remark, that it is this ſoft earthy matter, which afterwards becomes the *cortex ſtriatus*, as will be fully demonſtrated in its proper place.

CHAPTER II.

Of the pulp, and formation of the bony part of a tooth.

THE pulp ſeems intended for a purpoſe ſimilar to that of the cartilaginous matter of the other bones, though the proceſs of its oſſification is conducted in a different manner. A tooth is formed from without inwards, the part firſt formed being the outermoſt layer, which is as large, and probably as perfect at firſt, as at any ſubſequent period of life. I allude here to that part only of the outermoſt layer, on which the fibres of the cortex ſtriatus are afterwards to be arranged.

Oſſification commences on the higheſt or moſt prominent point of what is afterwards to be the cutting edge or grinding ſurface of the tooth; as alſo, on as many points, as there are eminences on the pulp. The bony matter being firſt depoſited on theſe points, it neceſſarily becomes hollowed towards the pulp, and gradually augmenting, at length forms over it ſmall elaſtic ſhells.

On the *inciſores* and *cuſpidati*, whoſe formation is more ſimple than that of the others, there is in general only one ſhell formed *, but on the grinders ſeveral of them appear. On the anterior or ſmall grinders, there are four ſhells formed, ſometimes however but two †. On the poſterior or large grinders there are in general five ſhells, of which, in the under jaw, three are placed externally or next the cheek, and two internally *. In the upper jaw, they are ſo ſituated, that their eminences are adapted to the hollows of the oppoſite teeth in the under jaw. †. As oſſification advances, the baſes of theſe ſhells come in contact, and at length unite, ſo as to form one ſhell ‡, after which, oſſification proceeds for ſome time, as in the Inciſores and Cuſpidati, gradually extending over the greater part of the pulp; and when ſo far advanced as to form the body of the tooth, it begins to contract from without, thus ſhaping the neck, from which the root or roots are to commence §.

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* Tab. i. Fig. 1. g. g. h.

† Tab. i. Fig. 1. i.

As the bone of the tooth increaſes in thickneſs, the pulp is proportionally diminiſhed, and ſeems as it were converted into bone; its connexion however with the bony part is very ſlight, except at its extreme elaſtic edge, ſo that when the membrane ſurrounding the tooth is

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* Tab. iv. Fig. 1.

† Tab. iv. Fig. 8.

‡ Tab. iv. Fig. 2. and 9.

§ Tab. iv. Fig. 3, b.

cut open, the ſhell can be taken from off the pulp, without any apparent violence; indeed, without altering the ſhape of the pulp, or ſcarcely its connexion with the veſſels. When the ſhell is removed, the pulp appears covered with a very delicate membrane, on which the veſſels form a net-work. This ſeems to be a propagation of the *perioſteum* which enters the canal of the jaw, along with the veſſels, and probably from whence are derived the bony lamellæ of which a tooth conſiſts *. Though this membrane is ſo ſlightly connected with the internal part of the ſhell, I cannot think Mr. Hunter's aſſertion warrantable, when he ſays, "nor are there any veſſels going from "the one to the other †." He might as well have denied the exiſtence of veſſels in the cryſtalline lens, as it more readily ſlips out of its capſula, than this pulp from its ſhell.

As the pulp has originally no proceſs anſwering to the root or roots, it has been ſuppoſed that it is lengthened, or ſqueezed out ſo as to form them, according as the cavity in the body of the tooth is filled up by the oſſification *. I have already mentioned that the pulp at firſt aſſumes little more than the ſize of the upper part of the body of the tooth, which is to be afterwards formed upon it; but it is depoſited and extends in proportion, as oſſification advances. It is the pulp and its veſſels which give a determinate ſhape and ſize to the body of the tooth, and it will in its proper place be ſhewn, that its proceſſes determine the ſhape and ſize of the roots. How is it poſſible that the ſimply filling up the cavity in the ſhell of a grinder, could occaſion the pulp to lengthen out into two, three, and ſometimes four roots?

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* Tab. i. Fig. 8. a. b.

† Nat. Hiſt. p. 89.

Of thoſe teeth which are to have but one root, the pulp increaſes in length as I have deſcribed, becoming more and more contracted towards the point; and as oſſification advances, the bone forms on it a kind of conical tube †.

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* Nat. Hiſt. p. 90.

† Tab. iv. Fig. 23, 24, and 25. a. a. a.

But, in thoſe teeth which are to have more than one root, a beautiful proceſs is carried on. In the grinders of the lower jaw, which in general have but two roots, the pulp is divided into ſo many proceſſes, a little below the neck; at this period, there is but one general opening in the ſhell, from the oppoſite ſides of the edge of which, oſſeous fibres or little bars ſhoot acroſs, through the diviſion of the pulp; theſe meet and unite in the middle, and ſo divide the cavity of the ſhell into two openings, forming over it a little arch*. In the grinders of the upper jaw, which have in general three roots, the pulp is divided into as many proceſſes, and the oſſeous bars ſhoot through them, from as many different points in the margin of the ſhell, and uniting in the middle divide the cavity into three openings, two of which are placed externally, and one internally †. Sometimes an oſſeous point is depoſited in the centre of theſe proceſſes, and fibres ſhooting acroſs from the margin of the ſhell join it, which anſwers the ſame purpoſe *. From theſe openings, the proceſſes of the pulp commonly become more and more divergent, and oſſification extending on them forms a conical or flatted tube on each, as in teeth which have but ſingle roots †. Sometimes the pulp is divided at the neck only into two proceſſes; oſſification goes on for ſome time as uſual, but one or both of theſe become divided again, and ſo three or four roots are formed. I have met a few of the permanent grinders, in which the pulp did not divide into proceſſes, ſo that only one root was formed‡. The pulp continues to advance faſter than the oſſification §, until each proceſs has acquired its proper length and ſhape; then the pulp except where the veſſels and nerves enter, becomes entirely ſurrounded with bone.

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* Tab. iv. Fig. 3, and 4. a. a.

† Tab. iv. Fig. 10, and 11. a. a.

Mr. Hunter mentions ‖, "By the obſer-
" vations which I have made in unravelling
" the texture of the teeth, when ſoftened by

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* Albin. Acad. Annot. Lib. ii. p. 17.

† Tab. iv. Fig. 22. a. § Ibid. Fig. 5, and 12. a. a. a.

‡ Tab. iv. Fig. 31. a. ‖ Nat. Hiſt. p. 92.

" an acid, and from obſerving the diſpoſition " of the red parts in the tooth of growing " animals, interruptedly fed with madder, I " find that the bony part of a tooth is formed " of *lamellæ*, placed one within another. " The outer *lamella* is the firſt formed, and is " the ſhorteſt: the more internal *lamellæ* " lengthen gradually towards the fang, by " which means in proportion as the tooth grows " longer, its cavity grows ſmaller, and its ſides " grow thicker." Now from my obſervations, the fact is directly the reverſe; the outer *lamella*, which is the firſt formed is longeſt, the internal *lamellæ* become ſhorter and ſhorter, and the laſt formed is the ſhorteſt *. Hence in teeth with ſingle roots, the cavity of the ſhell is not only diminiſhed, but it recedes from the apex or cutting edge of the tooth, whilſt a conical tube is left for the admiſſion of veſſels, &c. the baſe of which ending in the body of the tooth, has its opening or point nearly in the extremity of the root †. The *lamellæ* of a grinder, are diſtributed more irregularly than thoſe of any other tooth, on account of the protuberances of its pulp. As its external *lamella* advances very ſlowly, a great number of the internal ones are advancing, at the time that the external *lamella* has got ſo far as to form the neck. So that the cavity of a grinder recedes from the grinding ſurface, more rapidly than that of any other tooth [*]. After the roots commence, the cavity is ſoon diminiſhed, the oſſification going on at the ſame time at both the upper and under parts of it [†]. As many conical or flatted tubes are left leading to the cavity, as there are roots; and as many hollows or depreſſions in the ſuperior part of the cavity, as there are protuberances on the grinding ſurface. The pulp, though very much diminiſhed, ſtill retains nearly its original ſhape [‡].

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* Tab. iv. Fig. 20, 21, 22, 23, 24 and 25. b. b. b.

† Ibid. Fig. 25. a.

It may appear ſingular, that the pulp ſhould not be entirely obliterated, and the oſſification completed, without any remaining cavity; it however affords this advantage, that the veſſels and nerves diſtributed on the ſoft membrane of the pulp may have free action and not be compreſſed; by which means the internal bony part of the tooth may be more readily nouriſhed.

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[*] Tab. iv. Fig. 20. b.

[‡] Ibid. Fig. 21, and 22. a. a.

[†] Ibid. Fig. 21, and 22. d. d.

It is aſſerted by a celebrated Anatomiſt, that he has conſtantly found two holes near the point of each root, for the admiſſion of veſſels, not only of the Inciſores and Cuſpidati, but alſo of thoſe of the Grinders; which he ſuppoſes to have been eſtabliſhed by nature, in order to guard againſt accident, leſt if one veſſel were injured or deſtroyed, the other might continue to nouriſh the pulp. I confeſs I was never ſo fortunate as to meet a ſingle inſtance of this kind, even in the Inciſores of large animals; except in ſuch caſes as Euſtachius mentions, where he ſays, (ſpeaking of the roots of the permanent grinders), "Many of thoſe "(ſc. roots,) being flattened, their ſides thus "approach; ſo that, inſtead of a circular "opening, an oblong one is formed, the cen-

"tral points of whoſe ſides coming into contact, leave at either end a ſmall canal [*] [†]." In ſuch roots, however, I have frequently found but one opening externally, for the admiſſion of veſſels &c. but after their entrance, each divided into two branches. HAVER mentions [‡], that in a tooth which had but one root, he met two paſſages, one at each ſide. This root muſt have been formed in the manner Euſtachius deſcribes. I have ſeen a few of the permanent Inciſores with almoſt two diſtinct roots, the Cuſpidati with two, ſometimes with three roots, and the Grinders with four and even five roots, and of courſe as many openings as roots.

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[*] Tab. iv. Fig. 7. a.

" [†] Sæpe enim earum multæ hanc ob cauſam amplam rotunditatem in latitudinem mutant, cujus duæ extremæ partes quum ſe mutuo occurſu tangant, foramen anguſtum et oblongum efficitur, quod in medio fere obcæcatum duos parvos canaliculos utrimque obtinet:" *(Opuſcul. De Dentib.* p. 26.*)*

[‡] Oſteologia, p. 79.

CHAPTER III.

Of the gradual waſte of the membrane which ſurrounds the body of a tooth, and the period at which the temporary teeth in general appear.

THE membrane which depoſits the earthy matter of the *Cortex Striatus*, does not adhere to, but looſely ſurrounds the body of the tooth; but as ſoon as the neck is formed, the margin of the membrane adheres to it ſo firmly at that part, that it cannot be ſeparated from it, without lacerating ſeveral veſſels, which paſs from it to the bone. The membrane becomes much thinner at this part, and I could not ſeparate it at any period into two lamellæ *.

As oſſification advances on the root or roots, the body of the tooth riſes in the ſocket, and of courſe the inveſting membrane riſes with it.

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* Tab. iv. Fig. 12, b.

The *Cortex Striatus* is firſt perfected or cryſtallized on the cutting edges or protuberances of the tooth, and proceeds gradually from thence to the neck where it terminates; and in proportion as the firſt part of the *Cortex Striatus* is cryſtallized, that portion of the membrane which formed it becomes thinner, leſs vaſcular, and at length, having performed the particular function for which it was deſtined, is totally waſted or abſorbed. The gum alſo partakes of this tendency to waſte, and the tooth gradually appears through it; part of the membrane ſtill remains on the body of the tooth *, this however is waſted, as the *Cortex Striatus* covered by it attains to perfection. So that all that portion of the membrane, which looſely ſurrounded the body of the tooth, is deſtroyed when the tooth has riſen to its proper height.

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* Tab. iv. Fig. 5, b.

De la Sonne *, and other phyſiologiſts, attempt to aſſign a cauſe, why the teeth riſe and paſs through the gum, by ſaying; that as roots are added, the bodies of the teeth are puſhed or forced up through the gum, this being ſofter than the bottom of the ſockets. But when we come to conſider the appearance of the permanent teeth, we ſhall be fully ſenſible how inadequate ſuch a theory is.

It has been mentioned by moſt authors, who have written on dentition, that the membrane which ſurrounds the body of a tooth, is ſtretched, bruiſed, and even lacerated by the increaſed ſize of the tooth; Dr. Underwood ſuppoſes it to be ſtrong and nervous, and adds †, "The moſt painful part of dentition, "and that in which children are moſt expoſed "to convulſions, is uſually from the teeth "cutting through the *perioſteum*, (or nervous "membrane mentioned above), that covers

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[*] Acad. des Scien. in 4to. L'an. 1752. Mem. p. 168.

[†] Diſeaſes of Children, vol. i. p. 213, and 214.

" the teeth." Van Swieten although he did not believe the temporary teeth had roots, ſays, " Theſe rudiments of the teeth are " placed in the ſockets of the jaws; but the " opening from each of theſe ſockets, is cover- " ed by a thick coriaceous membrane, which " muſt be bruiſed or even torn by the tooth " in burſting out; ſo that after the tooth had " burſt out, the ragged edges of this membrane " have been obſerved by the accurate *Herriſ-* " *ſant.* Theſe edges becoming dry, fall away " ſpontaneouſly. Therefore the tooth in en- " deavouring to make its way out, muſt exert " a conſiderable force, in order to break " through this membrane *."

" * Hærent illa dentium germina in alveolis maxillarum; ſed horum alveolorum exitus tegitur membrana ſatis denſa coriacea, quæ ab erupturo dente pertundi debet, quinimo lacerari; ita ut, poſt eruptionem dentis, laceræ hujus membranæ laciniæ obſervatæ fuerint ab accurato in ſimilibus indagandis *Herriſſant.* Exſiccatæ dein hæ laciniæ ſponte cadunt. Magna ergo ſatis vis a dente erupturo fieri debet, ut hanc membranam rumpat."

Comment. vol. xiv. p. 743.

It appears rather ſtrange that Van Swieten could imagine, that the temporary teeth, which in another part of his work, he obſerves, have no roots, could perform all theſe violent efforts, ſo as to burſt through this membrane. Even Mr. Hunter ſays*, “When “the tooth cuts the gum, this membrane or “capſula is likewiſe perforated; *after which* “it begins to waſte.” Others are of opinion, that the membrane being lacerated, the body of the tooth paſſes up through it, and that it afterwards becomes the perioſteum of the root. From what I have already ſaid, the impoſſibility of a tooth burſting or riſing through its membrane will be eaſily perceived, for as it is firmly united to the neck of the tooth, it muſt partake of the ſame preciſe motion with the tooth, and therefore muſt after ſuch motion of the tooth retain the ſame relative poſition towards it, as before. So that the diſappearance of the membrane is not owing to a rupture of it, but to a waſting or abſorption of it, in proportion as it has perfected the *Cortex Striatus*. This fact will be more fully explained, when we come to ſpeak of the teeth of animals in general. I have ſeen the ragged edges of the membrane, appearing above the level of the gum; a ſimilar appearance was no doubt obſerved by Heriſſant, though he attributed it to a wrong cauſe.

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* Nat. Hiſt. p. 87.

Galen, Euſtachius, and others were of opinion, that the upper teeth appeared ſooner than the under; they were fully aware however, that they appear irregularly and at different periods. Mr. Hunter deſcribes their appearance in the following words *. "The "*inciſores* begin to cut or paſs through the "gums; firſt, generally in the lower-jaw; but "the *cuſpidatus* and *molares* of the fœtus, are "not formed ſo faſt as the *inciſores*; they ge"nerally all appear nearly about the ſame time, "viz. about the twentieth or twenty-fourth "month; however, the firſt grinder is often "more advanced within the ſocket than the *cuſ*"*pidatus*, and moſt commonly appears before "it." Chirurgical writers in general, give us a moſt curious jumble, reſpecting the appearance during dentition; and moſt of the ſtrenuous advocates for cutting and hacking the gums of children, ſeem perfectly ignorant of the order in which the teeth appear. Dr. Underwood ſays*, "The two front teeth in the "lower jaw are uſually cut the firſt, and it is "commonly a few weeks longer, before the "correſponding ones in the upper jaw make "their appearance. After which, it is fre- "quently a conſiderable time before the next "under teeth come out; but ſometimes, though "not often, ſix or eight are cut in a haſty "ſucceſſion. Children ſometimes cut their "teeth irregularly, or croſs, as it is called, both "by the teeth appearing firſt in the upper "jaw, and alſo at a diſtance, inſtead of being "contiguous to each other: this is accounted, "and with ſome reaſon, an indication of pain- "ful or difficult dentition." It is unneceſſary at preſent, to enter more fully into the inaccuracies of theſe authors, or to ſay any thing reſpecting their operations, (which were all blindly, and I muſt ſay, very often raſhly performed for want of anatomical knowledge of theſe parts,) as I intend to enlarge conſiderably on this ſubject, when I come to treat on dentition.

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* Nat. Hiſt. p. 78.

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* Diſeaſes of Children, vol. i. p. 205.

As oſſification does not commence on all the pulps at the ſame time, in general thoſe on which it firſt commenced are ſooneſt perfect, and of courſe they appear through the gum firſt. I have obſerved on examining the teeth of a number of children at birth, that the bodies of the middle *inciſores* of both jaws were moſt perfect; the lateral *inciſores* and the ſmall grinders next; and the *cuſpidati* and large *grinders* leaſt perfect [*]. In general the teeth begin to appear about the ſixth, ſeventh or eighth month after birth; but there are ſome exceptions to this rule; owing to the rapid progreſs of oſſification in ſome children, and the ſlowneſs of it in others. There are a few inſtances of children at birth having one or two of the *inciſores* already cut, and in ſuch caſes it is often neceſſary to remove them immediately; on the contrary, in children apparently healthy, they have not begun to appear till the firſt, ſecond, or even the third year. They for the moſt part appear in pairs, or the two correſponding with each other, nearly at the ſame time. The firſt are the middle *inciſores* of the under jaw, in a few weeks after the middle *inciſores* of the upper; in a month or ſix weeks after, we have reaſon to expect the lateral *inciſores* of the under jaw, and in a ſhort time after thoſe of the upper; about the twelfth or fourteenth month, the anterior or ſmall *grinders* of the under jaw appear, and frequently about the ſame time thoſe of the upper; about the ſixteenth or twentieth month the *cuſpidati* appear firſt in the lower jaw, and from the twentieth to the thirtieth month the poſterior or large *grinders* appear in the ſame order: ſo that in general about the ſecond or third year, the twenty temporary teeth are complete.

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[*] Tab. i. Fig. 3. h. h. i. k. k.

We muſt not expect however to find the teeth always appear in the preciſe order I have juſt now mentioned. I have frequently met with ſome irregularities, ſuch as one tooth appearing a conſiderable time before its fellow; all the *inciſores* of the under jaw, appearing before any of the upper; and the reverſe, though very ſeldom, has ſometimes taken place; the anterior *grinders* ſometimes appear ſooner than the lateral *inciſores*, and the lateral *inciſores* of the upper jaw, ſooner than thoſe of the under; I have ſometimes obſerved the poſterior *grinders* appear earlier than the *cuſpidati*; but I never ſaw an inſtance of the *cuſpidati* appearing previous to the ſmall *grinders*; ſometimes three or four teeth appear nearly at the ſame period, but I never met an inſtance of the *cuſpidati* and *grinders* appearing in ſuch rapid ſucceſſion as Mr. Hunter and Dr. Underwood mention. Dr. Armſtrong ſays *, that he met two caſes, where the ſmall *grinders* appeared firſt of all; I have lately met a caſe ſimilar; however by carefully examining the gums of a child, we can ſeldom miſtake what tooth is about to appear, as the gum is frequently ſomewhat higher over it, than elſewhere*, or it becomes ſo thin, that through it the ſhape of the tooth can be perceived.

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* Diſeaſes of Children, p. 82.

CHAPTER IV.

Of the commencement and formation of the permanent teeth.

HAVING now fully traced the temporary teeth, from their origin to their perfect ſtate; that I may be better underſtood, I ſhall follow nearly a ſimilar plan, with reſpect to the permanent. I think it unneceſſary to dwell on the ingenious hypotheſes of Veſalius, Diemerbroek and others, who ſuppoſed that the bodies of the permanent teeth were produced from

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[*] Tab. 1. Fig. 4, and 5. a. a.

from the old roots of the temporary. Diemerbroek adduces in ſupport of his doctrine an inſtance of the ſtag, who changes his horns every year, or year and half, when as he ſuppoſed from their old roots, new horns aroſe; but a full account and refutation of theſe opinions may be ſeen in the works of the learned Albinus *. Fallopius ſuppoſed, that a certain latent ſeed in the jaws produced a new range of teeth †. But Euſtachius explained much more clearly what takes place, than any of his predeceſſors, and indeed comes very near the truth, in the following words. "On "diſſecting a child immediately after birth, "both jaws being laid open, the *inciſores*, *ca-* "*nini* and three grinders appeared, partly gela- "tinous, partly bony, of no ſmall ſize, and "completely ſurrounded by their ſockets; but "having carefully removed the *inciſores* and "*canini*, I obſerved a very thin interſtice, "ſcarcely converted into bone, which being "removed with equal care, I diſcovered the "like number of *inciſores* and *canini*, almoſt

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* Acad. Annot. lib. II. p. 3.

† Obſervat. Anatom.

" gelatinous and of a ſmaller ſize, which lying
" behind the former ones, and in their
" proper cavities, were placed directly oppoſite
" to one another. I confeſs, I did not ſee
" any trace of the grinders and jaw teeth
" which appear about the ſeventh year, and
" often much later *.

Urbain Hemard, an ingenious French anatomiſt, makes uſe of nearly the ſame words, when treating on this ſubject. " He had diſſected,
" in preſence of his friends, capable
" of underſtanding this demonſtration, ſeveral
" infants three or four days old, and

" * Fœtu, ſimul atque editus eſt, diſſecto, aperta utraque
" maxilla, occurrunt *inciſores*, *canini*, ac tres *molares*,
" partim mucoſi, partim oſſei, non obſcuræ magnitudinis,
" ſuiſque præſepiolis undique vallati; *inciſoribus*
" autem et *caninis* docta manu detractis, tenuiſſimum interſtitium
" vix oſſeum factum conſpicitur, quo pari diligentia
" amoto, obviam veniunt totidem *inciſores* et *canini*
" pene mucoſi et longe minores, qui poſt alios
" priores in propriis caveis latentes, ſinguli ſingulis e regione
" oppoſiti collocati eſſent; *molarium* et *genuinorum*
" qui circa ſeptennium, ac longe etiam poſtea oriuntur,
" fateor me nullum veſtigium vidiſſe." *Opuſcul. de Dentib.* p. 46.

“ others juſt born; he found that the *inciſores*, “ the *canini* and ſome *molares* on each ſide of “ the jaws, were in part bony and in part mucilaginous, “ of middling ſize, and ſurrounded “ by their little caſes or ſockets; that after “ having removed the firſt *inciſores* and *canine* “ teeth, he obſerved a bony partition; and “ that after having likewiſe removed this, he “ met under it, as many new *inciſores* and *canine* “ teeth, as there were of the firſt, almoſt entirely “ mucilaginous. But as to the great “ *molares*, which at ſeven or eight years old, “ or a long time after, begin to appear through “ the gum, he confeſſes, he never found any “ trace or beginning of them *.”

It

“ * Il avoit anatomiſé, en préſence de ſes amis capables “ de cette démonſtration, pluſieurs enfans nez depuis “ trois ou quatre jours, et d’autres à l’inſtant de leur “ naiſſance, il á trouvé que les inciſives, les canines, et “ pluſieurs molaires de chaque côté des machoires, étoient “ en partie oſſeuſes, et en partie mucilagineuſes, de “ médiocre grandeur, et entourèes de leurs petits ètuis, “ ou alvéoles; qu ’après avoir tiré dehors les premieres “ dents inciſives et canines, il avoit remarqué un entre “ deux oſſeux; et qu’ après l’avoir pareillement ôté, il

“ avoit

It appears that Urbain Hemard was not acquainted with Euſtachius's work, ſo that he is entitled to an equal ſhare of merit; and although the celebrated Albinus confirms the deſcription of theſe parts, as related by Euſtachius, yet Dr. Neſbitt thought them imaginary, and ſays *, "There is not at birth, as Euſtachius imagined, the leaſt appearance that I "could ever find of the layer or row of teeth, "by which the firſt is afterwards uſually "thruſt out." Since ſo great an anatomiſt as Dr. Neſbitt did not credit the demonſtrations of Euſtachius, though ſupported as I already mentioned by Albinus, becauſe ſimilar appearances did not occur to him, and finding ſuch an imperfect deſcription of their origin in Mr. Hunter's work, I have diſſected a great

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"avoit rencontré deſſous tout autant de nouvelles dents "inciſives et canines qu'il y'en avoit auparavant, preſque toutes mucilagineuſes. Quant aux groſſes mo- "laires, qui à ſept ou huit ans, ou longtems après, com- "mencent à ſortir, il confeſſe n'en avoir jamais trouvé "aucune trace, ni commencement." *Fauchard Chirurgien Dentiſte,* Tom. 1re p. 37. *et ſeq.*

* Hum. Oſteogeny, p. 98.

number of infants to aſcertain this point, which I think of the greateſt importance.

I have already mentioned, that in the youngeſt fœtus I examined, I obſerved the rudiments of the four anterior permanent grinders*, though I could not diſcover the ſlighteſt appearancc of any of the other permanent teeth. But in a fœtus about the eighth month, I found the commencement of the ſacs of the *inciſores* and *cuſpidati*; they were not placed under the temporary teeth, nor indeed ſo deep in the jaw, but within ſide of them, that is to ſay, in contact with their inner ſurface, lying between that and the internal plate of the alveolar proceſs, and as Albinus remarks, they were contained in the ſame ſockets with the temporary †. In a fœtus between the eighth and ninth month, theſe ſacs were all perfectly diſtinct, and the pulps of the middle inciſores were tolerably advanced, they were elongated a little in the ſockets, and the jaws happened to be ſo far advanced, that the upper ſurface of the ſockets of the middle permanent *inciſores* were oſſified, the lower part remaining ſtill membranous: the other ſockets were leſs perfect, and exactly in that ſtate as deſcribed by the accurate Euſtachius. In children ſomewhat farther advanced, I found them nearly as Hemard mentions, and I confeſs I did not obſerve in ſuch young ſubjects the ſlighteſt veſtige of thoſe which ſucceed the temporary *grinders*, or any appearance of the middle permanent ones.

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* Vide Chap. 1. Page 1.

† Oſſium Fœtûs Humani.

Having fully ſhewn that the aſſertions of Euſtachius, Hemard and Albinus are true, I come now to treat more at large, of the relative ſituation and connexion of the rudiments of the permanent with the temporary teeth, which have been hitherto unaccountably overlooked. By the writings of thoſe great men we are informed, that a certain number of the permanent teeth began to be formed previous to birth, but we are ſtill perfectly ignorant reſpecting the manner of their formation or connexion; and have had nothing to guide us but imaginary conjectures, reſpecting the teeth which appear at a more advanced period of life. I think it unneceſſary to ſay any thing on the hypothetical ſuppoſitions of Hippocrates, Fallopius, Euſtachius, &c. but will dwell on the facts which I have diſcovered, and which I mentioned to a few celebrated anatomiſts, five years ſince in London.

When the rudiments of the temporary teeth are tolerably advanced, the internal part of the gum, or rather the upper part of each membrane deſtined to form one of the temporary teeth, ſends off a new ſac. Theſe ſacs, ſituated as juſt now deſcribed, are each at firſt contained in the ſocket of the one to which it is to ſucceed; and are ſo intimately connected with the membranes of the temporary teeth, that they cannot be ſeparated without tearing one or both, and may be torn along with the firſt ſacs out of the ſockets *. This circumſtance might have miſled Dr. Neſbitt, but it is ſtrange he did not obſerve the commence-

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* Tab. i. Fig. 3. e. e. f

ment of the permanent ſockets, which are very evident in every ſubject I examined, juſt before or at birth. Theſe ſacs were obſerved by the ingenious Mr. Hunter, for he ſays *, "There is another pulpy ſubſtance oppoſite "to that which we have deſcribed; it adheres "to the inſide of the capſula, where the gum "is joined to it, and its oppoſite ſurface "lies in contact with the baſis of the above "deſcribed pulp, and afterwards with the new "formed baſis of the tooth: whatever emi-"nences or cavities the one has, the other has "the ſame, but reverſed, ſo that they are "moulded exactly to each other.

"In the *Inciſores* it lies in contact not with "the ſharper cutting edge of the pulp, or "tooth, but againſt the hollowed inſide of "the tooth; and in the *Molares* it is placed "directly againſt their baſe, like a tooth of "the oppoſite jaw. It is thinner than the "other pulp, and decreaſes in proportion as

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[*] Nat. Hiſt. p. 94, and 95.

“ the teeth advance. It does not ſeem to be “ very vaſcular. The beſt time for examining “ it is in a fœtus of ſeven or eight months old.

“ The enamel appears to be ſecreted from “ the pulp above deſcribed, and perhaps from “ the capſula which incloſes the body of the “ tooth. That it is from the pulp and capſula, ſeems evident in the horſe, aſs, ox, ſheep, “ &c. therefore we have little reaſon to doubt “ of it in the human ſpecies.”

Now, whether we are to underſtand, by the words “ the pulp above deſcribed,” that which he ſpeaks of, as connected to the membrane of the firſt pulp, or the firſt pulp itſelf, he has left us quite at a loſs to determine. At all events, with the nature, uſe, and formation of this ſecond pulp he ſeems to be utterly unacquainted; for he firſt leaves us, as I before ſaid, in doubt, whether its uſe be to form the *cortex ſtriatus* of the firſt teeth, a thing next to impoſſible; and again he ſays, that in proportion as the teeth advance, it becomes thinner, which is actually the very reverſe of what really happens. I need hardly add, that there are no ſuch pulps as he deſcribes to be found on the baſes of the temporary grinders, (another inaccuracy which he has ſtrangely fallen into,) but merely a thickening of their proper membranes.

As the ſacs of the permanent teeth advance, the ſockets of the temporary ones become enlarged, and little niches are formed in the internal plate of the alveolar proceſſes anſwering to each ſocket, which are ſituated rather laterally, that is to ſay, at a greater diſtance from the ſymphyſis or centre of the jaw, than the centre of each reſpective temporary ſocket *. Theſe niches do not penetrate ſo deep as to the bottom of the temporary ſockets, but encreaſe in proportion with the ſize of the permanent ſacs, and gradually form a diſtinct ſocket round each of them. There is however, an opening left immediately under the gum, through which the membranes of both ſets of teeth continue to be connected †. The pulps of the *inciſores* in general are ſo far advanced at birth, that ſoon after oſſification commences on them: In a child about ſix or ſeven months old, I found their ſhells much more advanced than *a priori* I could have expected, and thoſe of the *cuſpidati* alſo had begun to oſſify. The ſacs of the *bicuſpides* which ſucceed the anterior grinders had appeared, yet I did not remark thoſe which were to ſucceed the poſterior grinders, although thoſe of the middle permanent grinders had already commenced *.

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* Tab. iii. Fig. 2. E E.

† Tab. iii. Fig. 2. e e.

In a child about four years old, the bodies of ſome of the permanent teeth were very much advanced, oſſification had commenced on the *bicuſpides* †; all the points of oſſification of the middle grinders were united, and the membranes of the poſterior grinders or wiſdom teeth were forming ‡. I have examined a number of children's jaws about this age, and found in general a ſimilarity of ap-

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* Tab. i. Fig. 5. b. b. c. c. d. d. e. Fig. 4. h. and for their connexion, Fig. 6. a b.

† Tab. ii. Fig. 2. h h.

‡ Tab. ii. Fig. 1 and 2. and the explanation.

pearance with reſpect to the number of teeth which were then formed, and alſo thoſe which were forming. So that I may ſafely ſay, there are more teeth formed and forming at this, than at any other period of life, that is, twenty-ſix teeth in each jaw.

Soon after the ſacs of the permanent teeth have commenced, a very curious and beautiful proceſs takes place, for they retain their ſituation at the bottom of the jaw, whilſt at the ſame time, the temporary teeth riſe and appear through the gum. The alveolar proceſſes become enlarged, or ſeem to riſe in proportion to the elongation of the roots of the temporary teeth; ſo that the permanent teeth appear now conſiderably beneath them, and conſequently the membranes which connect the permanent with the temporary teeth, are very much elongated, and appear as nervous twigs, paſſing up to the gum and neck of the temporary teeth. The ſituation as well as connexion of both ſets of teeth, can be eaſily underſtood from the repreſentations in Tab. i.

Fig. 6. a. b. and Tab. ii. Fig. 1 2, 3, 4, and 5.

Albinus was perfectly acquainted with the *foramina* through which the connecting membranes paſſed, and concerning which he makes uſe of the following words. " The ſockets " in which the permanent *inciſores* are con- " tained, extend to the margin of the jaw; " not far from it gradually becoming more " contracted, and at length terminating in a " ſmall hole: the hole which belongs to the " ſocket of the firſt *inciſor*, is placed behind " the firſt of the deciduous *inciſores*, in the in- " terval between it and the ſecond: that " which belongs to the ſecond, in like manner " is placed behind the ſecond of the deciduous " inciſores, in the interval between it and the " *canine* tooth. The ſocket of the new *canine* " tooth, extending only a little beyond the " bottom of the ſocket, in which the decidu- " ous *canine* tooth is contained, thence ter- " minating in a narrow little canal, before it " terminates in this canal, it gradually becomes " more contracted. The ſockets of the new

“ jaw teeth *(the bicuſpides)* do not extend by “ any hole to the margin of the jaw. I find “ theſe penetrate into the bottom of the de- “ ciduous ſockets, and firſt indeed near to the “ internal part of its roots *.” Nothing can be more accurate than this deſcription, but it has been taken from dried jaws, otherwiſe he certainly would have diſcovered the connecting membranes.

We have ſeen the membrane of the poſterior temporary grinder, and that of the ante-

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“ * Cavernulæ, quibus tomici novi continentur, ad “ maxillæ marginem pertinent, non longe ab eo ſenſim contractiores, et ad poſtremum in exiguum foramen deſinentes: quorum quod cavernulæ tomici “ primi eſt, id pone deciduorum primum eſt, ad illius “ ſecundique intervallum: quod ſecundi, id ſimiliter “ pone deciduorum ſecundum, ad intervallum illius et “ canini. Cavernulæ caninorum novorum tantummodo “ aliquantum ultra fundum præſepioli, cui deciduus inhæret, pertinentes, inde in anguſtum canaliculum “ abeunt, antequam abeant in eum, ſenſim contractiores. Maxillarum novorum cavernulæ nullo ad “ maxillæ marginem foraminulo pertinent. Hos invenio in fundum præſepioli decidui penetrare, et primum quidem juxta internam partem radicum ejus.” *Acad. Annotat.* lib. ii. p. 13, 14 and 15.

rior permanent grinder intimately connected together and contained in the ſame ſocket, but as the permanent grinder advances and the jaw increaſes in length, a proceſs is ſent backwards from the upper part of its membrane, which at firſt is contained in the ſame ſocket *. This proceſs gradually ſwells into a ſac, in which is contained the pulp, whence the middle grinder is to be formed; and as oſſification advances, the parts become ſeparated by a bony partition, the connexion however is ſtill kept up †. When the membrane of the middle grinder is tolerably advanced, it ſends off a proceſs in a ſimilar manner, to form the ſac of the poſterior grinder or wiſdom tooth ‡.

I think it abſolutely neceſſary to point out in this place ſome of the very great overſights and anatomical errors of Mr. Hunter; as his highly reſpected authority has frequently miſled the unexperienced practitioner: he ſays §,

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[*] Tab. i. Fig. 4. h.

[†] Tab. ii. Fig. 2. m.

[‡] Tab. ii. Fig 2. l.

[§] Nat. Hiſt. p. 82 and 83.

" The pulp of the firſt adult *inciſor*, and of " the firſt adult *molaris*, begin to appear in a " fœtus of ſeven or eight months; and five " or ſix months after birth the oſſification " begins in them; ſoon after birth the pulp " of the ſecond *inciſor* and *cuſpidatus* begin to " be formed, and about eight or nine months " afterwards they begin to oſſify; about the " fifth or ſixth year the firſt *bicuſpis* appears; " about the ſixth or ſeventh the ſecond *bicuſpis*, and the ſecond *molaris;* and about the " twelfth, the third *molaris* or *dens ſapientiæ*." It is evident that this deſcription is entirely theoretical, and not deduced from anatomical obſervation; for not a ſingle point of it will agree with what I have already demonſtrated. However, he has arranged his plates in ſuch a manner as to make them correſpond in ſome degree with his doctrine; for inſtance, in Tab. ix. Fig. 6 *. the teeth of a child ſix or ſeven months old are repreſented, ſome of the temporary *inciſores* were ſo far advanced as to have nearly cut the gum; the ſhells of the permanent *inciſores*, *cuſpidati* and anterior *grinders* were a little advanced, but the *cuſpidati* had not commenced in the upper jaw, yet he ſays, they are the teeth of a child eight or nine *years* of age. This error muſt ſurely be attributed to the printer.

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* Nat. Hiſt.

But in Plate x. Fig. 1. The teeth of a child he ſays of five or ſix years of age are repreſented, only the anterior *bicuſpides* of the upper jaw had commenced, the middle grinders had not. In the ſame plate Fig. 2. the teeth of one ſide of both jaws of a child of ſeven years of age are repreſented; all the ſucceeding teeth had commenced; but even at this period the middle permanent grinders had not. He mentions, "This is an "age in which there are more teeth formed, "and forming than at any other time of "life," though the entire number by his calculation amounts to but forty-four. When I come to treat on the ſhedding of the temporary teeth, we ſhall find that ſome of the permanent *inciſores* appear through the gum before ſeven years; or that the roots of ſome of the temporary teeth, inſtead of being perfect as Mr. Hunter has repreſented them, are entirely waſted. Again in Plate xi. Fig. 2. ſimilar miſtakes have been committed, for he ſays, in a youth about eleven or twelve years old, the two firſt *molares* of the ſecond ſet were ſo much advanced that they had cut the gums. Now theſe teeth in general appear about the ſixth or ſeventh year; and in the ſame plate he repreſents the bodies of the middle and poſterior grinders only as ſlightly formed.

It is unneceſſary to recapitulate what I have demonſtrated in the commencement of this chapter. Indeed it appears as an eſtabliſhed Law of Nature, that there ſhould be more teeth formed and forming at four or five years of age, than at any other period of life, that is, in all fifty-two. Yet, Mr. Hunter has repreſented at ſeven years only forty-four, and at nine years forty-eight, excepting that at the latter period the middle temporary *Inciſores* of the under jaw had been ſhed.

Although I omitted ſaying any thing particularly reſpecting the formation of the permanent teeth, when treating of the oſſification on the pulp of the temporary; I think however from the obſervations then made *, a few words more will now ſuffice.

The *inciſores* and *cuſpidati* reſemble their predeceſſors but are much larger, but thoſe which ſucceed the temporary *grinders* differ very much from them, in ſize and ſhape, being about one third ſmaller. Oſſification commences on them in general by two points, the ſhells formed round each of theſe points gradually unite, and oſſification goes on then for ſome time as in the *inciſores* and *cuſpidati*, until the greater part of the root is formed, which commonly divides in the upper jaw into two proceſſes near the extremity. I have met ſometimes two diſtinct roots proceeding from the neck; in the under jaw in general they have but one root †. Now the grinders which they ſuceed have four or five points on their grinding ſurface, and in the upper jaw they have commonly three diſtinct roots; in the under jaw two. Nor, according to the celebrated Albinus, do they differ only in their number of points, but in their entire figure, by which we can readily diſtinguiſh one from the other. Although the accurate Euſtachius remarks, thoſe of the under jaw in general want the internal point *, I think the term *bicuſpides*, which Mr. Hunter has given them ſufficiently applicable, as it at once diſtinguiſhes them from the temporary grinders; on which account I retain it, particularly as it has been the term made uſe of in practice for ſome years ſince.

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* Vid. Chap. II.

† Tab. iv. Fig. 14, 15, 16, 17, 18 and 19.

As to the permanent grinders, the anterior have each five points, the middle grinders four, ſometimes five points, and the poſterior or Wiſdom teeth three or four. In other reſpects their formation is exactly ſimilar to that of the temporary grinders, but they are much larger. In the under jaw they have in general two roots, in the upper three*, but the poſterior, though they have ſometimes two, three, or even four diſtinct roots, ſeem moſt commonly to have but one.

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* Tab. iv. Fig. 18.

CHAPTER V.

Of the Increaſe of the jaws

IN a fœtus three or four months old, the rudiments of the teeth are placed nearly regular; but as they increaſe more rapidly than the arch of the jaws, we find ſome of them at birth as it were preſſed out of the circle for want of room, particularly the Cuſpidati; ſo that the ſockets of the lateral Inciſores and thoſe of the anterior Grinders nearly come in contact. However the jaws gradually accommodate themſelves to the teeth, and increaſe at this part nearly in proportion to the ſize of

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[*] Tab. iv. Fig. 7 and 13.

of the Cuſpidati, becoming again regular, for indeed we ſeldom or ever meet the temporary teeth irregular. This Mr. Hunter allows, but ſays *, " The jaw ſtill increaſes in all points " till twelve months after birth, when the " bodies of the ſix teeth are pretty well formed; but it never after increaſes in length " between the ſymphyſis and the ſixth tooth; " and from this time too, the alveolar proceſs " which makes the anterior part of the arches " of both jaws, never becomes a ſection of " a larger circle; and after this time the jaws " lengthen only at their poſterior ends." Mr. Hunter ſuppoſed, as the temporary grinders are larger than the Bicuſpides which ſucceed them, that the difference in ſize of theſe would be ſufficient to allow the permanent Inciſores and Cuſpidati, which are much larger than their predeceſſors, to become regular, without any increaſe of the arch or circle. He was led into this opinion by comparing four lower jaws of different ſubjects, and at different periods of life; from

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* Nat. Hiſt. Page 102.

the age when the five temporary teeth are completed, to that of an entire permanent ſet. He acknowledges, however, that it is impoſſible there ſhould be a mathematical exactneſs in four different jaws; nor indeed is there a mathematical exactneſs in the lines drawn to ſupport his theory, for they are by no means parallel *.

Indeed ſo varied are the dimenſions of jaws, that the arch of one a year old may correſpond, or even exceed the arch of an adult; and *vice verſa*, the arch of an adult may be nearly as large again as that of a child; ſo it is not by comparing different jaws together that we ſhall be enabled to draw proper concluſions; but by comparing the permanent and temporary teeth of the ſame jaw.

It appears from my preparations, and experience convinces me, that the ſpace occupied by the temporary teeth would not be ſufficient to accommodate the ſame number of permanent teeth which ſucceed them, and which on the whole are ſo much larger, particularly in the upper jaw. This fact Mr. Hunter was aware of, and mentions that irregularities are more frequently met with in the upper, than in the under jaw; ſo far I agree with him.

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* Nat. Hiſt. Plate 16. Fig. 2.

We have ſeen the rudiments of the permanent teeth at firſt placed nearly regular *, but as oſſification advances on them, they become crowded together for want of room. This irregularity particularly happens to the permanent teeth, becauſe they are at firſt ſituated at the internal part of the jaw, and of courſe in a much ſmaller circle than the temporary. As I have given an accurate repreſentation of the jaws of a child about four years old, and the ſituation and connexion of both ſets of teeth, in plate 2d, fig. 1ſt, and 2d, very little is required to be ſaid on this ſubject. In the under jaw the lateral permanent Inciſores hide nearly half the middle

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* Tab. iii. Fig. 2. e. e. E. E f. f.

ones, and the lateral Inciſores and anterior Bicuſpides are ſo cloſe together, that the Cuſpidati would not have near room enough to paſs up between them. In the upper jaw there is a much more confuſed appearance, and a more ſtriking contraſt with reſpect to the difference in ſize of both ſetts of teeth, the lateral Inciſores reſt in part on the middle ones, and the ſockets of the lateral inciſores and anterior Bicuſpides nearly come in contact; ſo that the Cuſpidati are entirely thrown out of the circle*. We have ſeen alſo that the pulps and membranes of the permanent teeth were at firſt very ſmall, and that the ſockets were in proportion; but as the pulps enlarged and oſſification advanced on them, the ſockets increaſed likewiſe. It is but juſt, therefore to ſuppoſe, that as the teeth riſe and appear through the gum, the alveolar proceſſes ſhould accommodate themſelves to them; which indeed will preſently appear to be the caſe. If Mr. Hunter was a Practitioner in this branch even with very little experience, he muſt have frequently obſerved in children of about ſix or ſeven years of age, (if the firſt teeth had not already fallen), large diſtances between the Inciſores, which at firſt were quite cloſe to one another. I have ſeen hundreds of inſtances in which the four permanent Inciſores appeared irregular, but in a ſhort ſpace of time became perfectly regular without any artificial aſſiſtance. In a preparation of Dr. Munro's, (which he was kind enough to allow me to take a ſketch of,) the four permanent Inciſores of the under jaw had appeared, and alſo the two middle Inciſores of the upper, and were perfectly regular, though the temporary Cuſpidati and Grinders had remained in, in the former, and the lateral Inciſores Cuſpidati, and Grinders in the latter* Surely then, theſe teeth could have gained no room from the difference in ſize of the Grinders and Bicuſpides; it muſt therefore be owing to an increaſe of the arches of the jaws in theſe parts, exactly in proportion to the difference in ſize of the temporary and permanent inciſores. There is ſtill in this caſe a further neceſſity for a conſiderable increaſe of the arches, on account of the irregular ſituation of the permanent teeth as well as becauſe ſeveral of them had not as yet arrived at their full ſize.

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* Tab. ii. Fig. 1. k.

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* Tab. iii. Fig. i.

The preſſure of the front teeth on one another as they riſe in the jaw, appears to have ſome effect in occaſioning it to extend at certain parts, or to make the grinders move backwards, to which indeed all the teeth have a tendency. I have a preparation of the upper jaw of an adult, in which the temporary cuſpidatus of the right ſide remained in; the permanent cuſpidatus probably from the reſiſtance of the former, penetrated at the internal part of the mouth; in the left ſide the teeth are all perfectly regular: on comparing the ſituation of the anterior permanent grinders, I found that of the right ſide nearer the ſymphyſis, than that of the left in proportion to the difference in ſize, of the temporary and permanent cuſpidati. I have met ſeveral inſtances of the permanent cuſpidati appearing at firſt irregular, as they moſt commonly appear later than the bicuſpides, but in ten or twelve months after the jaw increaſed ſufficiently, ſo as to allow them to become regular. I have met many caſes where the arches of the jaws continued to increaſe, even after the permanent teeth were complete; ſo that all the front teeth were quite ſeparate from each other; and in one caſe the middle inciſores were nearly half an inch aſunder, though there was no defect in the palate.

From what is now ſaid I feel myſelf juſtifiable in concluding, that the alveolar arches continue to increaſe during the entire progreſs of the formation of the teeth; it is however ſufficiently evident, the greateſt increaſe of the jaw is backwards. I do not by any means deny but that we frequently meet with diſproportions between the jaws and teeth, and ſuch that the permanent teeth never would become regular without the aſſiſtance of art, even in young perſons; this may ariſe from the reſiſtance of the temporary teeth, or from teeth forming ſo much out of the circle that they have not ſufficient power to act on their neighbours and preſs them back, ſuch as the cuſpidati, which are moſt commonly irregular. Indeed if Mr. Hunter's hypotheſis were true, we would never ſee a regular ſet of teeth.

CHAPTER VI.

Of the ſhedding of the temporary teeth, and of the period at which the permanent appear.

WE meet with ſuch ſtrange opinions in the works of a celebrated author (Van Swieten) reſpecting the temporary teeth, that I think it worth while to inſert ſome extracts from them: He ſays "I have taken out and "examined ſeveral of the firſt teeth when "they begin to looſen, and in moſt of them

“ I did not obſerve the ſlighteſt appearance “ of a root. This ſurprized many ſurgeons, “ who, in the treatment of diſorders of the “ teeth, were eſteemed exceedingly ſkilful. “ They were of opinion that the teeth which “ are uſually ſhed about the ſeventh year have “ had roots, but when they took out thoſe “ that were already looſe, they found no “ roots. To account for this, they ſaid that “ the ſecond tooth while it riſes, rubs away the “ roots of the firſt, and ſo reduces them to the “ moſt minute powder, which, being ſo very “ fine entirely diſappears, for no body could “ ever perceive it. But could the action of “ the ſecond tooth gently riſing, whilſt it “ moves the firſt out of its place, be ſo great “ as to reduce the roots of them to powder? “ Bourdet, celebrated for his ſkill in this “ branch of ſurgery, aſſerts, that the firſt teeth “ before they looſen have roots nearly as “ ſtrong and hard, as the ſecond are obſerved “ to have. And whilſt he refutes the opinion of Bunon, who ſuppoſed the roots “ of the firſt were deſtroyed by the friction of

" the ſecond teeth when riſing, he refers to " thoſe which are found in the jaws of freſh " ſubjects, at that period when the ſecond teeth " are forming; and the firſt (called milk teeth) " are ſtill in their ſockets; whether they are " ſtill firm, or are more or leſs looſe. For it " ſeems that the ſecond tooth whilſt it riſes, " remains encloſed in its proper membrane, " until it is about to appear. Therefore a " membrane is interpoſed between the roots " of the milk tooth and the ſecond tooth. " However the roots of the milk teeth are " deſtroyed before the ſecond teeth can touch " them. Beſides a ſmall ſpace is obſerved " between the firſt and ſecond tooth, from " whence Bourdet concludes, that the roots " of the milk teeth are deſtroyed by ſome " other cauſe, and not by the friction of the " ſucceeding teeth. He therefore thought " that ſome acrid humour was ſecreted from " the neighbouring parts, which might conſume their roots. I muſt confeſs it appears to me much more probable, that the " milk teeth are without roots.

" Nevertheleſs ſome obſervations ſeem to " ſhew that the milk teeth, if they are not " ſhed at the proper period, or when looſe " are not taken out, are capable of protruding roots from their body, by means of " which they often remain fixed in the jaws " through life *."

It

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* " Plures dentes primos, dum vacillare incipiunt, " eductos examinavi, et in plurimis ne veſtigium " quidem radicis inveni. Mirabantur hoc chirurgi peritiſſimi, qui in dentium morbis curandis verſatiſſimi " merito habebantur. Statuebant, dentes, qui circa ſeptimum annum cadere ſolent, radices habuiſſe: dum " illos, jam vacillantes, leviſſimâ vi educebant, nullas " radices inveniebant. Ut hoc explicarent, dixerunt, " ſecundum dentem, dum aſſurgit, atterere radices " prioris, et ſic comminuere in minutiſſimum pollinem, " qui præ tenuitate ſuâ evaneſceret totus; nam nemo " illum unquam invenit. An lentè aſcendentis dentis " ſecundi, dum primum loco movet, actio tanta eſſe " potuit, ut prioris radices in pollinem comminueret? " Egregius in hâc chirurgiæ parte *Bourdet* ſtatuit, " primos dentes, antequam vacillent, habere radices " æque fortes fere, et duras, quám obſervantur in ſe-

" cundis

* Comment. Vol. XIV. pag. 743. et ſeq.

It is almoſt ſuperfluous to mention that the temporary teeth have as perfectly formed roots as the permanent, indeed as far as I re-

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“ cundis. Dum autem refutat ſententiam *Bunon*, qui ſtatuebat, radices illas a frictione aſcendentis dentis ſecundi deſtrui, provocat ad illa, quæ in recentis cadaveris maxillis inveniuntur, dum ſecundi dentes jam oſſei fieri incipiunt, et primi dentes, (lactei dicti), adhuc adſunt; *ſive firmi adhuc hæreant*, ſive jam plus minùſve vacillare inceperint. Apparet enim, dentem ſecundum, dum aſſurgit, ſuà membranâ involutum manere, donec exitui proximus ſit. Radicibus ergo dentis lactei et aſſurgenti denti ſecundo interponitur membrana. Radices tamen dentium lacteorum deſtructæ jam ſunt, antequam ſecundi dentes illas tangere poſſint. Præterea parva diſtantia obſervatur inter dentem primum et ſecundum; unde concludit, radicem dentis lactei conſumi ab aliâ cauſâ, non veró per attritum dentis ſuppoſiti. Hinc maluit credere, ab adjacentibus partibus ſecerni acriorem quemdam humorem, qui illas radices conſumeret. Fateor quód mihi longe probabilior videatur opinio, quæ ſtatuit dentes lacteos carere radicibus. Videntur tamen obſervationes docere, quód dentes lactei, ſi non cadant ſuo tempore, aut jam vacillantes non eximantur, apti ſint, ut radices protrudant ex ſuo corpore, quibus poſtea fixi in maxillis hærent ſæpe totâ vitâ.

collect, Van Swieten is the only perſon who at all doubted the fact.

Mr. Hunter ingeniouſly obſerves,* "An "opinion has commonly prevailed, that the "firſt ſet of teeth are puſhed out by the "ſecond; this, however, is very far from "being the caſe: and were it ſo, it would be "attended with a very obvious inconvenience; "for were a tooth puſhed out by one under"neath, that tooth muſt riſe in proportion to "the growth of the ſucceeding one, and ſtand "in the ſame proportion above the reſt." Mr. Hunter, however, does not ſeem to be acquainted with the writings of the very accurate Albinus; if he was, he would be induced to give a very different deſcription of what takes place, with reſpect to the waſting of the roots of the temporary teeth and the appearance of the permanent, as will appear from the following quotations. Mr. Hunter ſays †, "It would be very natural to ſuppoſe "that this waſting was owing to a conſtant

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* Nat. Hiſt. page 98.

† Nat. Hiſt. page 98 and 99.

“ preſſure from the riſing teeth againſt the “ fangs or ſockets of the firſt ſet: but it is not “ ſo; for, the new alveoli riſe with the new “ teeth, and the old alveoli decay in propor- “ tion as the fangs of the old teeth decay, “ and when the firſt ſet falls out, the ſucceed- “ ing teeth are ſo far from having deſtroyed, “ by their preſſure, the parts againſt which “ they might be ſuppoſed to puſh, that they “ are ſtill incloſed, and covered by a complete “ bony ſocket. From this we ſee, that the “ change is not produced by a mechanical “ preſſure, but is a particular proceſs in the “ animal œconomy.” And in page 100, he makes uſe of the following words, “ When “ the *inciſores* and *cuſpidati* of the new ſet are “ a little advanced, but long before they ap- “ pear through their bony ſockets, there are “ ſmall holes leading to them on the inſide, “ or behind the temporary ſockets and teeth; “ and theſe holes grow larger and larger, till at “ laſt the body of the tooth paſſes quite through “ them.” Mr. Hunter ſupports this theory ſtill farther in page 90. Sc. “ As the body

“ of the tooth is puſhed out, the ſocket at
“ the ſame time contracts at its bottom, and
“ graſps the neck, or beginning fang, adheres
“ to it, and riſes with it, which contraction
“ is continued through the whole length of
“ the ſocket as the fang riſes; or the ſocket
“ which contained the body of the tooth,
“ being too large for the fang, is waſted or
“ abſorbed into the conſtitution, and a new
“ alveolar portion is raiſed with the fang.” Theſe obſervations of the ingenious Mr. Hunter are however entirely hypothetical and do not accord with anatomical truth; indeed they entirely overturn ſome of his former opinions. For if, as he affirms, the permanent teeth were formed, at the internal part of the jaw and in a new ſeries of alveolar proceſſes, it is evident that they muſt neceſſarily be placed in a ſmaller circle than the temporary teeth. And if the proceſſes and ſockets of the temporary teeth, as Mr. Hunter aſſerts, were abſorbed or totally deſtroyed, the permanent ſockets ſhould extend to the anterior part of the jaw, accommodate themſelves

to the teeth and thus form a ſegment of a larger circle *.

Albinus however comes very near the truth, for when ſpeaking of the holes by which the connexion between the membranes of the permanent and temporary teeth were preſerved, he ſays, " As the new teeth increaſe, the con-
" tracted part of the ſockets is gradually di-
" lated, and afterwards in like manner the
" little opening, and thus they appear.—
" But if previous to the formation of the new
" teeth, the temporary had fallen out, or were
" looſened in conſequence of their roots being
" waſted, then the ſocket of the temporary
" tooth is gradually deſtroyed, while that of
" the other being dilated anteriorly, the new
" tooth paſſes into its place, ſo that the root
" of the new tooth is contained in a ſocket
" formed partly of that in which it was be-
" fore, and partly of the ſocket which belong-
" ed to the temporary tooth. But if contrary
" to what commonly happens, the tooth

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* Vid Chap. v.

" which ought to be ſhed, is not ſhed, then " the permanent tooth appears behind it and " remains ſimilar to it fixed in its own ap- " propriate ſocket *."

Had Albinus been acquainted with the uſe of the ſmall holes leading to the permanent teeth, he would immediately have diſcovered what uſually takes place.

I have already ſhewn that the temporary and permanent teeth were about the fourth year, ſeparated from each other by a bony partition, each tooth being at this period contained

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[*] " Creſcentibuſque novis, ſenſim dilatatur cavernula- " rum pars illa contractior, poſteaque et oſtiolum : ac ſic " erumpunt. Si autem, novi antequam nati ſint, de- " cidui ceciderint, aut perdita radice plane vacillent, " tunc ſenſim ſimul deletur decidui præſepiolum, no- " vique cavernulâ antrorſum dilatatâ, hic in locum " illius ſuccedit ut ex novi cavernula, parteque præſepioli " decidui, præſepiolum, quod novi radicem contineret, " formaretur. Sed ſi quando non decidit is, qui cadere " debuit, tunc novus pone eum naſcitur, ſuo inhærens " præſepiolo, ut prior ille." Acad. Annot. lib. ii. pag. 14 et 15.

tained in a diſtinct ſocket. Now according as the permanent teeth riſe, they have a natural tendency to come more and more to the anterior part of the jaw; whilſt in conſequence of the preſſing forward of the riſing tooth, a change is induced in the mode of action of the ſurrounding veſſels, ſuch, that that portion of the bony partition immediately preſſed upon, as well as the root of the temporary tooth, with the adjacent parts, become fit to be abſorbed, and actually are abſorbed.

In ſome caſes part of the roots of the neighbouring temporary teeth, are abſorbed; particularly where the jaw does not increaſe as rapidly as the permanent teeth. So that in proportion as this abſorption takes place, the permanent tooth paſſes partly into the ſocket of the temporary tooth proper to it, and partly into the ſockets of the neighbouring temporary teeth. And as Albinus juſtly remarks, a ſocket is formed for the reception of the root of the new tooth, in part, by its own appropriate ſocket, and in part by the temporary ſocket of the tooth with which it was originally connected, and ſometimes in part by the neighbouring temporary ſockets *. When the permanent teeth paſs into the cavities which ſurrounded their membranes, they are always very irregular and appear as Albinus remarks at the inſide of the temporary teeth, which frequently remain in their ſituation †. This irregularity however is ſeldom the caſe, unleſs where the temporary teeth retain their roots, and reſiſt the influence of the permanent. In ſome caſes they appear more internally than the cavities through which the connecting membranes paſſed ‡. It is worth remarking, that when the temporary teeth fall out, if we examine their bodies, we find them quite excavated, and the bony part reduced nearly to its former pulpy ſtate §.

Mr. Hunter, in ſupport of his theory, has repreſented the waſting of the roots of the tem-

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[*] Tab. iv. Fig. 32. and 35. This fact is very beautifully exemplified in a preparation of the head of a young horſe in my poſſeſſion.

[†] Tab. iv. Fig. 34. b. d.

[‡] Ibid. Fig. 33. b.

[§] Ibid. Fig. 29. a.

porary teeth, as it were proceeding from the point gradually upwards to the neck *. This, however, is ſeldom or never the caſe, for the part firſt affected is conſiderably above the point; how this takes place will be eaſily underſtood by viewing plate II. fig. 5. and plate iv. fig. 26. 27. and 28. This circumſtance Albinus was fully aware of, and has given drawings to illuſtrate it †.

With reſpect to the appearance of the permanent teeth, Dr. Hudſon in a letter he wrote to me at Edinburg, judiciouſly remarks, " The time of ſhedding is very va-
" rious, happening a year or two or three
" earlier or later in ſome than others; and
" in many ſubjects ſome of them remaining
" to adult or even old age; and this is ſo
" common, that almoſt every day I meet
" with them, from one to three or four, or
" double the number, in the ſame perſon.
" I have ſeen two inſtances where ſcarcely

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[*] Nat. Hiſt. Plate xv.

[†] Acad. Annot. lib. II. Tab. ii.

" any of them fell, and ſuch I may affirm
" muſt have been thoſe hiſtoric facts handed
" down to us, of a third ſet appearing in the
" old age of heaven-favoured mortals, where
" it could be nothing elſe than the then
" matured ſecond ſet. Such I have met with,
" but never any thing like a third ſet, at
" leaſt, which I was convinced was ſuch."
It appears from the foregoing obſervations, that the permanent teeth, whilſt they are riſing in the jaw, have conſiderable influence with reſpect to the waſting of the temporary roots; for while they are at reſt, the roots of the temporary teeth are not waſted. However, it does not appear to me, that the waſting of the temporary roots, is in any degree the effect of mechanical trituration, as Mr. Bunon and other authors would affirm.

In general, children begin to ſhed their teeth about ſix or ſeven years of age, and the permanent appear nearly in the following order: Firſt the middle Inciſores of the under jaw, ſoon after, thoſe of the upper; then the lateral Inciſores of the under jaw, and nearly at the ſame time the anterior Grinders; then the lateral Inciſores of the upper jaw appear, though ſome time elapſes between their appearance and that of the former: the anterior Bicuſpides appear about the 9th year, the poſterior about the 10th or 11th, and the Cuſpidati and middle Grinders nearly at the ſame time, that is about the 12th or 14th year; and finally, the poſterior Grinders or wiſdom teeth from the 16th to the 25th year. Though, as Dr. Hudſon remarks, there are many exceptions to this general rule, yet I do not think it neceſſary to dwell ſo much on the order or period of their appearance, as I have done with reſpect to the temporary.

The anterior permanent Grinders frequently appear a conſiderable time before any of the temporary teeth are ſhed, and there are many varieties with reſpect to the wiſdom teeth, for in ſome caſes they do not appear till a very late period of life, ſometimes they appear in one jaw and not in the other, and ſometimes it has been obſerved that in extreme old age they have not perforated the ſockets. It is certainly a curious fact, how very long ſome of the permanent teeth remain within the jaws, without appearing; and if there ever was a third ſet of teeth, it is ſufficiently evident, that their rudiments muſt have been depoſited, previous to the appearance of the ſecond ſet through the gum.

CHAPTER VII.

A few practical obſervations reſpecting the Temporary Teeth.

I apprehend that Mr. Hunter's theory reſpecting the increaſe of the jaws, has led him and thoſe who followed his directions, into egregious practical errors; he makes uſe of the following words*: "From the manner

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* Nat. Hiſt. Page 106 and 7.

“ in which the teeth are ſhed, it is evident
“ that drawing a temporary tooth, for the
“ eaſier protruſion of the one underneath,
“ will be of no great ſervice; for in general
“ it falls out before the other can touch it.
“ But it is often of much more ſervice, to
“ pull out the neighbouring, or adjacent
“ temporary tooth; for we muſt be convinced
“ by what has been advanced with regard
“ to the changes in ſize, that excepting
“ the whole were to ſhed at the ſame time,
“ or the order of ſhedding, viz. from before
“ backwards, were to be inverted, that the
“ ſecond ſet of *Inciſores* and *Cuſpidati* muſt
“ be pinched in room, till the Grinders are
“ alſo ſhed: and therefore we find it often
“ of uſe to draw a temporary tooth, that is
“ placed further back; and it would, perhaps,
“ be right upon the whole, always to
“ draw, at leaſt the firſt Grinder; and, perhaps,
“ ſome time after, the ſecond Grinder
“ alſo.”

I need ſcarcely obſerve that this mode of treatment is altogether improper. The practice which Dr. Hudſon of this city introduced nearly forty years ago, and ſtill retains, entirely coincides with my obſervations; he was fully aware of the increaſe of the jaws, which appears from theſe his remarks, "The indiſcriminate practice of drawing children's teeth before they looſen is erroneous: the intent of making greater room for the ſecond ſet is thereby directly defeated. Let the propriety be hence inferred of a timely and regular domeſtic attention to the teeth and gums, it will prevent many painful diſorders and operations, and leave Nature undiſturbed in the production of the permanent teeth, to the great diſappointment of the expecting charlatan." There are ſome exceptions, however, to this general rule; for it is neceſſary ſometimes to remove a few of the temporary teeth: ex. gr. if the roots of theſe teeth are not waſted in proportion as the permanent teeth riſe in the jaw, thereby affording ſuch reſiſtance, as to occaſion them to appear at the internal part of the mouth*: or where the jaw does not increaſe in proportion to the difference in ſize of the temporary and permanent teeth, by which means the permanent teeth are turned quite acroſs in the ſockets. The propriety, however, of performing ſuch operations muſt be left to the judgment of the practitioner. The operations recommended by Mr. Hunter, I look on to be very injurious, for that preſſure or proper degree of reſiſtance and connexion (were the temporary teeth taken out prematurely) would be removed, which ſeems to me altogether neceſſary to the perfection of the permanent teeth.

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* Tab. iv. Fig. 34. b.

It would be quite foreign to the nature of this eſſay, to enter into a deſcription of the great variety of diſeaſe to which the teeth and gums are ſubject. Let us ſuppoſe, however, that ſome of the temporary teeth are diſeaſed, or what is commonly called carious; if they are ſo far injured as to occaſion violent pain to the child, and if palliative remedies fail to give relief, we cannot heſitate about the propriety of taking them out. Having already obſerved that the alveolar proceſſes of the temporary teeth are not obliterated or abſorbed, as Mr. Hunter ſuppoſed, we ſhould be very careful leſt diſeaſes of theſe teeth or gums ſhould materially injure them, which indeed is too often the caſe. When the caries of a tooth has proceeded ſo far as to communicate with the cavity where the veſſels are contained, the ichorous matter, or the air admitted into the cavity coming in contact with the membrane of the pulp, occaſions an inflammation of it, which frequently communicates with the external perioſteum of the root. When the inflammation has advanced to a certain degree, ſuppuration takes place, and a conſiderable ſac or abſceſs is thus formed*, which being filled with purulent matter, occaſions an abſorption or waſting of the alveolar proceſs near the apex of the root, and in this way a paſſage is at laſt made through the proceſs, forming what is commonly called a gum-boil. The opening is uſually made between the cheek and jaw; ſometimes however, it burſts externally, and leaves a diſagreeable cicatrix or ſcar through life. So that in ſuch caſes the neceſſity of removing the temporary teeth is obvious, in order to avoid ſuch diſtreſſing conſequences as theſe, and others which are even yet more particularly dangerous.

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* Tab. III. Fig. 12. b. b.

It is the opinion of many celebrated Anatomiſts, that diſeaſes of the temporary teeth cannot injure the permanent, even though the diſeaſed parts were to come into contact with them. I am ſorry to ſay I have ſeen many inſtances of the contrary; though previous to my having obſerved the connecting membranes, I was totally at a loſs how to account for the injuries communicated from one to the other. The following caſe, which occurred to me about ſix years ago in this city, will illuſtrate the ſubject remarkably well.

A lady brought a child to me about ſix years old, to have the anterior temporary Grinder of the under jaw taken out; the tooth was very much diſeaſed, and the point of one of the roots ſtuck out of the jaw, and occaſioned an ulceration of the cheek. On inſpecting the mouth, I found the tooth quite looſe, and a conſiderable portion of the alveolar proceſſes attached to it, which had been ſeparated from the neighbouring or ſound parts. I removed the entire with a curved probe, and having immerſed the extracted portion in water, in order to examine it, I found it to conſiſt of the entire ſocket of the temporary tooth, and alſo the ſocket in which the *bicuſpis* was forming, part of the body of which was tolerably advanced; the earthy matter of the cortex ſtriatus was quite black, and perfectly ſoft *. The ſockets of the neighbouring teeth fortunately were not much injured. On enquiring into the hiſtory of this caſe, I was told that about two years previous the child had had a ſlight fit of the tooth-ache which ſubſided, and ſoon after a gum-boil was formed, which frequently ſuppurated and burſt, after which the child would get relief for ſome ſhort interval. The mother, through timidity, or falſe affection for the child, could not be prevailed on to conſult any one, until forced to it by the conſequences already mentioned. The child without any other aſſiſtance got well, but the jaw remains very much contracted where the tooth was, with a correſponding hollow in the cheek.

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* Tab. III. Fig. 3. a. b. c. d. e.

I have ſince that period met three or four caſes, where two or three of the permanent teeth were ſloughed off by a ſimilar cauſe. Theſe caſes I account remarkably inſtructive, for they clearly point out the neceſſity of removing the temporary teeth, when any ſuch ulcerations or gum-boils are forming, particularly if they are of great extent, or long continued. Slight caſes, however, if properly attended to, might be retarded and probably entirely checked.

The inſtruments I have found beſt adapted for ſuch operations are thoſe invented by Dr. Hudſon *.

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* Tab. 7. Fig. 2 and 3.

CHAPTER VIII.

Of the Teeth in various Claſſes of Animals.

As well the ſtructure as formation of the teeth of graminivorous and ruminant animals, differ from what is obſerved to take place in thoſe of the carnivorous order. The food of the former requires a greater degree of comminution than that of the latter; for which purpoſe it becomes neceſſary, that the ſurfaces, between which this operation takes place, ſhall be as much as poſſible multiplied. That this object is fully provided for by nature, may be evinced by inſpecting the grinding ſurfaces of their teeth; for the *Cortex Striatus* not only covers the body of the tooth, but even deſcends through its ſubſtance, forming therein a variety of convolutions, and of courſe a variety of prominences in each accidental ſection of it *; ſuch parts of it being leſs liable to abraſion, than the other bony portion of which it is compoſed.

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* Tab. v. Fig. 10. and 12.

Many circumſtances however, particularly relative to their ſtructure and formation, have not been as yet at all attended to or explained, on which account I have endeavoured to trace them at different periods.

In the right ſide of the lower jaw of a fœtus calf about three months old, the internal plate of the alveolar proceſs being cut away, and the arteries injected, the rudiments of the teeth, their connexion with the gum, &c. appeared as they are repreſented in Tab. v. fig. 1.

The upper part of the pulp of a grinder is divided into a certain number of conical proceſſes, previous to the commencement of oſſification upon it; the number of theſe proceſſes varies according to the ſize, or kind of tooth; in ſome there is but one, in others two, four, or ſix of them. The pulp of the great grinder of the under jaw in the calf juſt now mentioned, was divided into ſix proceſſes, and on it as many bony ſhells were already formed. In the view given of it in Tab. v. fig. 2. three only of the ſhells can be ſeen, the others were placed exactly oppoſite and at a little diſtance from them; one of the ſhells has been removed and is repreſented in the ſame plate fig. 3. As oſſification advances, the proceſſes of the pulp elongate, whilſt the bony ſhells extend conſiderably on them previous to the junction of their ſides; they then form one continued ſhell exhibiting no trace whatever of their former ſeparation*. From the convoluted ſhape of the pulp, deep depreſſions are left at the junction of ſome of the ſhells, which are ſituated at the internal part of the mouth in the upper jaw, but at the external part in the under. In order to fill up theſe, or to ſtrengthen the tooth, one or two additional proceſſes are ſent off from the pulp, when oſſification has advanced ſomewhat on the original pulps, or when the ſides of the ſhells have been nearly united. Theſe proceſſes however do not riſe to an equal height with the firſt*, the upper teeth have but one of them, the under in general two.

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* Tab. v. fig. v. d.

The membranes which are intimately connected with or derived from the internal part of the gum, can be eaſily ſeparated into two *lamellæ*, the external of which is very vaſcular, though I could not trace a ſingle blood-veſſel entering into the internal one†; this appearance is beſt examined in fœtus calves about three or four months old. Theſe membranes ſurround the pulp, and duplicatures of them paſs down between the internal diviſions of it, exactly ſimilar to the paſſing of the *pia mater* between the convolutions of the brain. The duplicatures extend downwards until checked by the junction of the internal plates of the ſhells, which thus ſeparates them from the pulp‡. As ſoon as the bony ſhells are perceptible, the internal part of the membrane ſecretes and depoſits on their points and progreſſively on their ſides, a ſoft earthy matter ſimilar to moiſtened chalk, and is itſelf moiſtened with a mucilaginous fluid, a great quantity of which is found between the membrane and ſhells. This ſoft earthy matter gradually aſſumes the cryſtalline appearance of the *Cortex Striatus*, the fibres of which in fig. 7. are repreſented in contact with the membrane, the bony part in contact with the pulp.

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* Tab. v. fig. 4. c.

† Tab. v. Fig. 6. b. b.

‡ Tab. v. fig. 7. a. a. a. fig. 5. a. a. & b. and fig. 11. d.

When the cortex ſtriatus is perfectly formed down to the bottom of the convolutions or junction of the internal plates of the ſhells, the tooth begins to riſe by the increaſe of its roots; the upper part of the inveſting membrane at the ſame time waſting in proportion as the cortex ſtriatus covered by it attains to perfection, ſo that the tooth advances by almoſt imperceptible degrees 'till at length it appears through the gum. The protuberances of the tooth firſt appear, and thus intercept part of the nouriſhment from the duplicatures of the membrane which paſſed down into the internal cavities. That part of the tooth marked a. a. in fig. 8. had paſſed through the gum ſtill however fibres of it paſſed between the convolutions of the ſhell into the hollows, by which the membranes in them were ſtill in ſome degree ſupported; the gum is turned up and fibres of it are repreſented as if paſſing down into the cavities. When the tooth riſes ſomewhat higher, all nouriſhment is cut off from the internal duplicatures of the membrane which are then found dead and of a darkiſh purple colour*. The lower part of the membrane however remains on the external plates of the body of the tooth†, but is waſted in proportion as the cortex ſtriatus becomes perfect. The entire bodies of the temporary teeth when formed paſs through the gum, ſo that the whole of the inveſting membrane is deſtroyed as ſoon as they have riſen to their proper height. This deſcription however admits of a few exceptions, particularly with regard to the permanent grinders, the greater part of whoſe bodies remains within the jaw for a conſiderable time. A purpoſe of ſome conſequence in the animal œconomy, which I ſhall preſently endeavour to explain, is thus anſwered; and, as the proceſs by which it is completed is very different from what has been already deſcribed, it will be of uſe to point it out in the cleareſt manner.——It appears that the internal part of the membrane ſecretes the earthy matter of the cortex ſtriatus, and that as ſoon as it has performed its function it is waſted or deſtroyed ; for its external lamella, as ſoon as the upper part of the cortex ſtriatus is cryſtalliſed, begins to depoſit on its ſurface a ſubſtance differing from either the bony part or the cortex ſtriatus, being harder and more brittle than the former, and leſs ſo than the latter. It is likewiſe of a different colour and can be readily diſtinguiſhed from the other two component parts. As the ſurface of the cortex ſtriatus is ſmooth, this ſubſtance (which for diſtinction's ſake, I take the liberty of calling the *Cruſta petroſa)* cannot adhere firmly to it, and for this reaſon in the teeth of young animals it eaſily chips or ſcales off, when they are expoſed to the weather. In animals more advanced in life, the *Cruſta petroſa* fills up all the convolutions of the external plates of the cortex ſtriatus, and extends a conſiderable way beyond them, ſo as to form a great proportion of the grinding ſurface*, when it becomes much more conſolidated and with difficulty can be ſeparated from the cortex ſtriatus. The *Cruſta petroſa* not only covers that part of the tooth which appears through the gum, but alſo that part of it which remains within the ſocket, and in a few inſtances I have obſerved a ſmall quantity of it on the roots of the teeth of very old horſes. From this, and obſervations on the teeth of other animals which will preſently be mentioned, it would ſeem that the membrane may at once depoſit this matter, without having previouſly given riſe to the cortex ſtriatus. The *Cruſta petroſa* is depoſiting on the upper part of the tooth a long time previous to the cryſtalliſation of the lower part of the external plates of the cortex ſtriatus, and it continues to be depoſited as long as any part of the body of the tooth remains within the ſocket.

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* Tab. v. fig. 9. a. a. a.

† Fig. 8. c. c.

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* Tab. 5. fig. 10. and 12. d. d. d. d. and fig. 11. e. e.

The *Cruſta petroſa* ſeems intended to ſerve a variety of purpoſes: in the firſt place, to fill up the hollows in the ſides of the teeth, next the cheek and tongue, and render them even. 2dly. To ſupport and prevent the fibres of the cortex ſtriatus from ſplintering off or wearing down too rapidly. 3dly. To increaſe the grinding ſurface and render it more rugged, for it ſcarcely wears down as faſt as the bony part, yet faſter than the cortex ſtriatus. In ſome few inſtances the Grinders remain ſufficiently long under the gum, ſo as to allow the cavities, in which the membrane paſſed down to form the cortex ſtriatus, to be nearly filled by the *Cruſta petroſa.* In moſt caſes however, theſe cavities are filled entirely with the matter of the food, by the broken particles of the teeth whilſt grinding, or by particles of ſand, clay, &c. This adventitious matter remains quite ſpongy and of a different colour and texture from any of the other three above deſcribed parts ; in the cow it is of a blackiſh or dark-brown colour *. It is remarkably evident in the Grinders of the ſheep, in which the cavities are conſtantly filled with particles of graſs and clay ; the ſtructure and formation of their teeth being ſimilar to thoſe of the cow, except what regards the additional proceſſes.

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* Tab. v. Fig. 10. b. b. b. and Fig. 11. b.

The *Cruſta petroſa* ſeems intended for another and a very important purpoſe. The greater proportion of the cortex ſtriatus in graminivorous animals as already mentioned remains within the jaw for ſome years. Now the nature of this ſubſtance is ſuch, that membranes could not adhere to it, whilſt without the interpoſition of ſome ſuch ſubſtance as the *Cruſta petroſa*, or a total want of the cortex ſtriatus, a circulation of fluids through the ſocket could not take place. The *Cruſta petroſa* is therefore depoſited for the membranes to adhere to, and alſo to prevent the ſockets being injured by the violent motions performed in grinding. It cannot be miſtaken for a depoſition from the fluids of the mouth commonly called *Tartar*, for I juſt now mentioned that it is depoſited previous to the appearance of the tooth through the gum. A ſimilar ſubſtance I have obſerved on the Grinders of the Elephant *, Rhinoceros, &c. and even on the Grinders of the Rabbit and Hare, indeed it is to be met with in almoſt all graminivorous animals.

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* The ſtructure and formation of the Elephants' teeth I reſerve as a ſupplement to the preſent work.

The Grinders of the camel are nearly ſimilar to thoſe of the cow, the internal cavities of their teeth are in like manner filled with particles of graſs, clay, &c.

The formation of the Inciſores and Grinders of the horſe differs very much from thoſe of the cow, and probably from thoſe of all ruminant animals; for, as the horſe does not chew the cud, it was neceſſary his food ſhould be at once ſufficiently maſticated; his teeth and jaws of courſe are admirably fitted for this purpoſe.

The Grinders of the upper jaw commence by four points of oſſification, and are formed preciſely ſimilar to thoſe of the cow, except that additional proceſſes are not added, and that the internal cavities are moſtly filled by the *Cruſta petroſa*; although I have ſometimes obſerved the upper part of the cavities filled by the adventitious matter, as repreſented in Tab. v. Fig. 12. b. b. while the under part of them was occupied by the *Cruſta petroſa*. This only happens where the oſſification of the roots takes place more rapidly than the depoſition of the *Cruſta petroſa*, ſo that by the tooth penetrating the gum the nouriſhment is cut off (as already mentioned *) from the internal duplicatures of the membrane.

The formation of the Grinders of the under jaw, however, differs very much in thoſe animals; for though oſſification commences in the horſe on the pulp of the Grinders, by five or ſix points, which afterwards increaſe into as many ſmall ſhells, yet, as happens in the human ſubject, they unite without duplicatures of the membrane paſſing down between them to form internal plates of the cortex ſtriatus, which I before obſerved always takes place in the cow. This membrane however paſſes round the pulp in a very convoluted manner, and as the points of the ſhells and the interſtices between them are ſoon worn away by grinding, a ſection is thus formed in which one continued line of the cortex ſtriatus can be traced including the bony part alone within it, the *Cruſta petroſa* remaining without †. In all graminivorous animals the under jaw is much narrower than the upper, particularly at the anterior part, the under teeth are likewiſe at leaſt one third narrower, but by the lateral motion of the under jaw during manducation, different points of the under teeth can be ſucceſſively applied to the whole ſurface of the upper ones, the lateral motion correſponding exactly to the difference in breadth of the upper and under teeth.

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* Vide Page 83. † Tab. 9. Fig. 5 and 6.

The pulp of a front tooth in either jaw of a horſe is divided into two proceſſes: duplicatures of the inveſting membrane paſs down between them to a conſiderable depth, even greater than is repreſented in Tab. v. Fig. 7. a. which conveys an adequate idea of the ſection of one of theſe teeth whilſt forming.— The cavity in the middle of each of theſe front teeth is filled by particles of the food, &c. and ſometimes, though ſeldom, by the *Cruſta petroſa.* By the diſappearance or wearing down of the edges of theſe cavities and internal plates of the cortex ſtriatus, jockies determine the age of a horſe, or (in their language)

guage) by the filling or growing up of the cavity. Indeed ſo well acquainted are they with this circumſtance, that when the natural cavities diſappear, they form artificial ones, and fill them with a compoſition of reſin, clay, &c. to make them appear black, but ſuch fraud can be eaſily detected by obſerving whether there is a plate of the cortex ſtriatus bordering the cavity, or not. This method, as well as obſerving the period at which foals cut or ſhed their teeth, muſt be rather fallacious; the firſt depending ſo much on the quality of their food as will preſently be ſhewn; and the ſecond depending in a great meaſure on the conſtitution of the animal.

It is rather a curious circumſtance that horſes have 40 teeth in both jaws, and mares have only 36, the Cuſpidati commonly called tuſks being wanting in the latter; though their rudiments are formed in the jaws, they ſeldom or never appear, and if they do, as the celebrated Buffon remarks, they are ſcarcely diſcernible.

As the cow, ſheep, &c. have no front teeth in the upper jaw, it was neceſſary that the edges of thoſe in the under ſhould be very ſharp; the membranes of courſe do not paſs down into the internal bony part of them, but they are formed as ſingle teeth in general are.

Euſtachius, although he did not inveſtigate the ſubject fully, was aware of many circumſtances relative to it, which I cannot paſs over in ſilence. He ſays, "The ſituation of "the human teeth is at the extreme edge of "the circle of both jaws. In ſome of the "brute creation however, and in almoſt all "fiſhes, their ſeat is in the palate, the "tongue and even the ſtomach. Thoſe ani-"mals which ruminate, we are told by all "anatomiſts, have only an inferior range of "teeth, in which however they are incorrect, "for they do not want the entire of the up-"per teeth, but thoſe only which ſhould lie "in front*." When ſpeaking afterwards of ruminant animals, he deſcribes that peculiarity of formation in their teeth, by which they become liable to contain heterogeneous particles, thoſe eſpecially of the food on which they are nouriſhed *.

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* "Humanorum dentium ſedes eſt extremus tantûm "utriuſque maxillæ ambitus; quamquam multis bel-"luis,

All the points of thoſe teeth which we have been examining, had been at one time covered by the cortex ſtriatus, and the plates of it were all at that time intimately connected, ſo that one continued line of it could be traced as in Tab. 5. Fig. 7. It is evident, that in proportion as the cortex ſtriatus is worn off theſe points, the bony matter muſt appear between its plates, therefore in Fig. 12. the *Cruſta petroſa* is obſerved externally, then the cortex

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" luis, ſicut fere cunctis piſcibus, palatum quoque ac " lingua, et nonnullis aliis venter, pro ſede ſunt; et " quæ ruminant, ut anatomici omnes ſcribunt, inferi- " orem tantûm ordinem dentium habent, quod tamen non " ita intelligendum eſt, ut quiſpiam hoc ſermonis genere " deceptus putet, eas ſuperioribus dentibus prorſus ca- " rere, ſed illis tantum, qui ad ſuperius labrum perti- " nent."—Opuſc. de Dent. Page 9.

[*] Ibid. Page 56.

ſtriatus, within which is the proper bony part, including again two plates of the cortex ſtriatus, and in the middle of theſe the cavities filled by the food, &c. ſo that this tooth conſiſts of four different ſubſtances.

Mr. Hunter mentions in the deſcription of Plate xiv. Fig. 19. Nat. hiſtory. “ The ena-
“ mel paſſes through the whole length of the
“ tooth ; the enamel is repreſented by the
“ white lines which are penniform.” It appears ſtrange that Mr. Hunter ſhould fall into ſuch an error, nor can I conceive how he could, unleſs by a ſection ſimilar to the one repreſented in Plate v. Fig. 7. c. where the plates of the cortex ſtriatus approach ſo cloſe to each other, that at firſt ſight they appear penniform, but on cloſer inſpection there are bony lamellæ obſerved between them, on which the fibres of the cortex ſtriatus are arranged. Mr. Hunter's figure one would think had been drawn from an imaginary preparation, for in whatever direction a ſection were made, the appearances would have been different from what he has repreſented.

The windings, fibres and termination of the cortex ſtriatus are accurately repreſented in Fig. 7. and 11. of the ſame plate. The fibres paſs upwards in an inclined direction towards the grinding ſurface, by which means the entire fibre is not broken off at one time, and of courſe the teeth laſt longer than they otherwiſe would. When we ſplit or break a tooth of theſe animals, a beautiful ſilvery line is obſerved at the junction of the cortex ſtriatus and the bony part, as I have endeavoured to ſhow in Fig. 11.

According as the grinding ſurface of theſe teeth is worn down, (by the addition of bony matter to their roots and filling up of the ſockets,) they riſe in proportion, and continue to riſe until all the plates of the cortex ſtriatus are worn away, and even the roots. Sometimes they wear or are rubbed away very irregularly; I have ſeen an inſtance where a middle Grinder of the upper jaw was protruded near an inch lower than any of the others, and had worked a groove for itſelf between the lower teeth. I have ſeveral inſtances in my poſſeſſion leſs ſtriking, all of which muſt have been very troubleſome and detrimental to the poor beaſts, and might probably have been prevented by a judicious operation.

With reſpect to the connexion of the temporary and permanent teeth, I have found it in all animals I have examined, ſimilar to that already mentioned as ſubſiſting between thoſe of the human.

Thoſe animals that make uſe of their teeth as edged tools for cutting or ſcraping very hard bodies, ſuch as the ſquirrel, rat, &c. are ſupplied with two Inciſores in each jaw, moſt admirably adapted for theſe purpoſes. As the under Inciſores are principally made uſe of, they are nearly twice as long as thoſe of the upper; and indeed they are much longer than *a priori* I could have imagined, for they occupy the greater part of the jaw from the ſymphyſis to the roots of the coronoid proceſſes. In the under jaw of the ſquirrel for inſtance, the Inciſores form almoſt a ſemicircle, and the Grinders are ſituated within the ſegment of the circle *. In the upper jaw they form a ſegment of a much ſmaller circle, and do not extend even ſo far as the anterior Grinder.

The bodies of their Grinders are covered by the cortex ſtriatus; but it is depoſited only on the convex ſurface of the Inciſores, ſo that the extremity with which they gnaw conſiſts entirely of the cortex ſtriatus. The flatted ſides and concave ſurface are bone, in order that the external membrane might adhere to it and nouriſh the tooth, and alſo the bone being much ſofter than the cortex ſtriatus, it is more eaſily worn down, by which means the cortex ſtriatus is always prominent and retains a moſt acute edge †. The edge itſelf, hard as it is, is conſtantly wearing away; but in proportion to its waſte, the tooth is protruded by the addition of new oſſific matter to its baſe, and the curve of the tooth is ſuch that the edge of it always preſerves exactly the ſame ſituation with reſpect to the upper teeth.

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* Tab. 3. Fig. 9. a. a. a. and c. c. c. &c.

† Ibid. b. b.

By the curved form the teeth acquire additional ſtrength and are leſs liable to be broken than they otherwiſe would be. The ſquirrel I have juſt now ſpoken of, was domeſticated, and uſed to amuſe himſelf in chewing ivory which happened to be inlaid in ſome pieces of furniture.

The ſtructure and formation of the Inciſores of the beaver are preciſely ſimilar to thoſe of the ſquirrel and rat, and the colour of the cortex ſtriatus is likewiſe nearly ſimilar, being an orange or deep yellow. But there is a marked difference between the formation of their Grinders, for, as I juſt now mentioned, thoſe of the ſquirrel and rat are covered by the cortex ſtriatus, but in the beaver it paſſes in a very convoluted manner round the bony part, as in the under Grinders of the horſe, ſo that when the upper part of the tooth is ſlightly worn down, one continued line of the cortex ſtriatus can be traced *. Sometimes however an additional point is obſerved unconnected with the line

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* Tab. 9. Fig. 3. c. d. e.

of the cortex ſtriatus on the ſurface as at f.—The *Cruſta petroſa* fills up the external ſpaces left by the windings of the cortex ſtriatus.—This ſtructure is admirably contrived and fitted to the purpoſes of the animal; for its food, (as Buffon mentions) being principally the branches of trees, &c. it could not otherwiſe grind it ſufficiently; and to ſupply the conſequent waſte of the upper ſurface of the tooth, new oſſific matter is continually adding to the baſe, which appears hollow and convoluted as repreſented in Tab. 9. Fig. 4. b. without any appearance of roots being formed, which probably never are formed. We can eaſily conceive how they can cut down large trees, as mentioned by moſt hiſtorians, with ſuch powerful inſtruments as their Inciſores *.

The Inciſores and Grinders of the rabbit and hare, are formed in a ſimilar manner to thoſe of the beaver, but the Inciſores even in the under jaw do not extend further back than the anterior Grinder, and although the cortex ſtriatus is ſimilarly ſituated on them, it is of a different colour, being white. It is worth obſerving, that in theſe animals, (ſcil. the rabbit and hare) there are two ſmall teeth ſituated at the internal part of the Inciſores, both in the upper and under jaw, which ſcarcely appear above the level of the gum.

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* Tab. 9. Fig. 3. a. a. a.

From the foregoing obſervations, as well as many others, it appears that the Inciſores of all ſuch animals are never ſhed, but augment in proportion to the increaſed ſize of their jaws. Hence ariſe the various breadth and curvature of theſe teeth at different periods, and probably the protruſion of the tooth is owing to the continued growth of the bony matter from the ſurface or membrane of the pulp. Alſo on the peculiar curvature the ſafety of the ſofter or growing parts depends, the preſſure being confined to the prominent part of the tooth near the anterior part of the jaw, or towards the middle of the curve.

I have obſerved in all caſes where a great portion of the cortex ſtriatus was contained in the ſocket, and where the *Cruſta petroſa* would have been rather an inconvenience, portions of the bony part left without a covering of the cortex ſtriatus, in order that the tooth might be nouriſhed, and that part only covered by it which was intended for uſe, or expoſed to injury. In ſome animals the *Cruſta petroſa* alone is depoſited on their teeth, ſuch as the ſpermaceti whale, whoſe teeth are confined to the lower jaw.

I have obſerved a very beautiful contrivance, with reſpect to the different ranges of teeth with which ſome genera of fiſh are provided, for inſtance the ſkate, in one ſpecies of which the teeth are ſpear-pointed, and their points turned towards the throat; their chief uſe ſeems to be, to enable the animal to retain its prey, or to crack the ſhells of lobſters, crabs, &c. which are probably its chief food. Although their teeth are covered by a very hard cortex ſtriatus, they are nevertheleſs liable to be broken or worn down, by the ſhells of the animals they make uſe of. Nature however has wiſely guarded againſt premature old age, by continually forming ſeveral ranges of teeth, ſo that as one or more of the front ranges are

deſtroyed

deſtroyed or naturally ſhed, the lower ranges advance forward and ſupply their place.— How this circumſtance happens I will now endeavour to explain: their teeth are not fixed in bony ſockets, but attached to a cartilaginous or ligamentous matter which reſts on the jaw. Each tooth has two proceſſes or roots, and each root has a deep furrow near the neck*, by which means it is more firmly connected, and as the front ranges are ſhed, the cartilaginous matter is by ſome proceſs in the economy of the animal drawn forward, and with it the teeth, new ranges ſtill continue to form, I may ſay *ad infinitum*, while the ſame proceſs continues to take place. Theſe facts can be eaſily underſtood by viewing Plate vi. Fig. 1. in which two or three of the front ranges are repreſented broken or worn down, three or four of the ranges immediately under them are perfect and turning up to ſupply the place of the former, and although this was a very old animal, yet ſeveral ranges can be obſerved imperfect, covered with their proper

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[*] Tab. vi. Fig. 2. b.

membranes, and the earthy matter of the cortex ſtriatus was quite ſoft on them.

A contrivance ſomewhat ſimilar is obſerved in the common ſhark, whoſe teeth are ſpear-ſhaped, ſerrated at their edges and covered by a cortex ſtriatus as hard as that of the former animals. Theſe animals are ſaid to live to a very great age, and from the nature of their food, as well as the accidents they are expoſed to, their teeth are conſtantly in danger of being broken or torn away; to guard therefore againſt ſuch prejudicial effects, ſeveral ranges of them are formed and conſtantly forming. The upper range is placed nearly perpendicular on the margin of the jaw *, the under ranges are regularly diſpoſed quite flat one over the other, and their points are turned in an oppoſite direction to thoſe on the margin. When therefore one tooth or range of teeth is ſhed or torn away, the tooth or range of teeth immediately underneath begins to turn up and paſs into the place of the former †.

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* Tab. vi. Fig. 5. a. a.

† Ibid. Fig. 5. c.

Theſe teeth are inſerted in the cartilaginous matter of the jaw, as in the ſkate, and are ſo firmly fixed in it, that the animal has not power to move them at pleaſure, as was formerly ſuppoſed. The number of ranges does not ſeem determinate, and the under ones are quite imperfect, the earthy matter of the cortex ſtriatus being ſoft on them, but they gradually become more and more perfect towards the upper range. Their connecting membranes are ſimilar to thoſe obſerved in the human body, for the membranes paſs down from the upper range which is forming to the ſecond, from the ſecond to the third, from the third to the fourth, and ſo on to the 5th, 6th, or 7th.

The ſame appearances may be obſerved in the angel fiſh, which was ſaid to have had but four rows of teeth, but on cutting open the membranes, I found five or ſix of them.

Some months after I had written this chapter of my Theſis, and mentioned the obſervations contained in it to many of my friends in

Edinburgh, Mr. Robert Jameſon was kind enough to ſend me a tranſlation from the Italian of the Abbe Spallanzani's travels he received from London. In this work I was very much pleaſed to find many remarks by the Abbe and other authors in ſupport of my opinions *. He ſays, " we learn from Steno " that in the ſqualus carcharias (the ſhark) the " inner (rows of the teeth) are bent downwards, and are ſo encloſed in the ſoft and " fungous fleſh of the gums, that unleſs the " latter be cut away, they are not viſible.— " For what uſe the teeth thus bent were intended by nature I cannot diſcover; ſince " they are ſo buried within the fleſh, that they " cannot ſerve for grinding their food. The " teeth in the firſt row may, perhaps, be deſigned to prevent the prey from eſcaping, or " to divide it when too large to be received " into the ſtomach; but why the others were " formed I do not ſee, unleſs we ſay, that they " have been produced by the neceſſary action

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* Vol. iv. Page 358.

"of matter *." The Abbe ſays, page 359.— "But Heriſſant was of a different opinion.— "He found, after a very careful examination "of ſeveral jaws of ſharks, that the teeth, "more or leſs covered with fleſh, are teeth of "reſerve, to ſupply the place of thoſe of the "firſt row ſhould they chance to be loſt; in "which caſe, theſe which lie below, riſe out "of the fungous fleſh, and take the place of "thoſe that are wanting †." "From the "examination of ſeveral ſharks' jaws, I was "now ſatisfied that the teeth of the ſecond "row, which are bent towards the throat, are "not merely 'produced by the neceſſary action

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[*] "Interiores (ordines dentium) inferiora verſus re- "curvati, gingivarum molli et fungoſa carne ita deli- "teſcebant clauſi, ut non niſi refectis gingivis in con- "ſpectum prodirent. Cui uſui dentes ita incurvatos "natura deſtinârit, non perſpicio, cùm, carnes intra ſe- "pulti, eſcæ comminuendæ nullâ ratione potuerint "inſervire. Retinendæ prædæ, ne diffugiat, forſi- "tan et diffringendæ majori, qúam quæ ventrem ſubire "poſſit, primi ordinis inſerviunt: reliqui veró, niſi "materiæ neceſſitate facti, non video cujus gratiâ ſint "confecti."

[†] Mem. de l'Acad. Roy. 1749.

" of matter,' as Steno has ſuggeſted, but " deſigned by Nature to ſupply the place of " thoſe of the firſt row, when they may chance " to be loſt ; as was firſt diſcovered by Heriſſant ; and I flatter myſelf I am the firſt " who, ſince he wrote, has confirmed his ingenious and noble obſervation *." After theſe remarks it appears rather ſtrange that the Abbe Spallanzani ſhould doubt, that the teeth of every ſpecies of *ſhark* were intended to alter their ſituation, according as the exigencies of the animal required. For in deſcribing the jaws of a ſhark, nearly ſimilar to that I have repreſented in Tab. vi. Fig. 5. and which he calls the ſqualus of Meſſina, he obſerves † " One of the largeſt teeth in the firſt " row is wanting, being entirely detached from " the jaw. This loſs could not have been recent, when the fiſh was taken, as the fungous " fleſh had formed a ſcar over the place it had " occupied, producing an angular elevation " of ſome thickneſs. If, therefore, the ſecond " row of theſe teeth, and the ſame may be

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* Page 363 and 364.

† Page 373.

" ſaid of the other lower rows, had been de-
" ſigned by nature to ſupply the deficiencies
" that might happen in the firſt, it is evident
" that the tooth below would have occupied
" the place of the tooth wanting, or at leaſt
" would have raiſed itſelf up and approached
" nearer to it. The fact however is, that this
" tooth, which we might have ſuppoſed to be
" formed as a ſubſtitute, is by no means ſuch,
" but ſtill continues in the ſame poſition with
" the others, and covered in the ſame manner
" with the fungous fleſh." It is very obvious from the Abbe's remarks, that the tooth he alludes to, was not perfect, being covered by its proper membranes, and of courſe at this period could have no tendency to riſe or turn upwards; but moſt undoubtedly, if it had arrived at perfection, it would have paſſed into the place of the former. Surely if one of the temporary teeth of a child was prematurely taken out, the permanent tooth underneath would not immediately riſe up and ſupply its place.

A very ſingular contrivance I have obſerved with reſpect to the articulation of the teeth in the *Lophius piſcatorius* commonly called by fiſhermen the ſea-devil. The points of all the teeth are turned towards the throat, and each of them is joined at the internal part to an elaſtic cartilaginous or horny ſubſtance, which allows them to yield to the ſlighteſt external preſſure, ſo that they afford no reſiſtance to the animals it allures by its playfulneſs to enter its mouth, but the moment the external preſſure is removed, the elaſtic ſprings react and preſs the teeth back into their original ſituation. The external part of the teeth form a kind of fulcrum on the jaw, and reſiſt the preſſure from the internal part ſo ſtrongly, that I could not force one of them out of its ſituation *. The teeth placed in the ſtomach of this creature are ſimilarly conſtructed in order to prevent the eſcape of its prey.

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* Tab. vi. Fig. 3. and 4. and the explanation.

CHAPTER IX.

Of ſupernumerary Teeth, &c.

WHEN we conſider the formation of the teeth and the contiguity and intimate connexion ſubſiſting between their rudiments, we cannot be ſurpriſed to meet with ſuch frequent deformities and varieties as occur amongſt them. Though deviations in the ſhape or ſize of their bodies ſeldom occur, yet their roots vary conſiderably, ſome being much larger than thoſe commonly met with, others curved in different directions, or exceeding their uſual number.

Euſtachius, Juſſieux, Fauchard and other writers mention ſome inſtances remarkable for the ſingular poſition of the teeth in the jaws. They alſo ſpeak of having met with a few caſes where two or three of the front teeth and as many even of the Grinders were completely joined together by oſſification. I have met with more than a dozen caſes ſomewhat ſimilar, for inſtance the bodies and roots of the lateral temporary Inciſores and Cuſpidati joined together, and among the permanent teeth, the middle and lateral Inciſores as alſo the lateral Inciſores and Cuſpidati. Here it is evident both pulps muſt have been contained in the ſame inveſting membrane or ſac, for their oſſification is in general ſo complete that one hole ſerves to both for the admiſſion of veſſels, &c.*. In thoſe caſes the body of each of the teeth ſo conjoined commonly retains its own appropriate form, though both are completely ſurrounded by the cortex ſtriatus †— Amongſt the permanent teeth however I have met with one inſtance, where one of the middle and lateral Inciſores were ſo intimately united, that on viewing them externally they appeared as one large middle Inciſor, no trace being left of their having originally two diſtinct bodies ‡; but on the internal ſurface there is a very marked difference and each retained nearly its proper ſhape *. Excreſcences of the cortex ſtriatus are very ſeldom met with, one ſingular inſtance of it occurred to me, in a patient about 17 or 18 years of age. The right permanent cuſpidatus in this perſon did not appear through the gum until the ſixteenth year, on the ſide of it next the lateral Inciſor there was a bulbous protuberance of the cortex ſtriatus, with a hollow or depreſſion in the middle, this protuberance did not however extend to the apex of the tooth †. Between the bulbous part, and the perfectly formed body of the tooth, there was alſo a deep groove, which perhaps retained part of the inveſting membrane longer than uſual, or the external *lamella* of the membrane was not waſted, for there was a ſubſtance ſomewhat ſimilar to the *Cruſta petroſa* of graminivorous animals depoſited round the protuberance of the cortex ſtriatus, and even on a conſiderable portion of the root. This ſubſtance ſtuck out and formed a ſharp hook under the lip, which was very troubleſome to the perſon, and as there was not ſufficient room for the tooth in the arch of the jaw, it was of courſe adviſeable to have it removed *. This is the only inſtance I have met with, or even heard of, where a *Cruſta petroſa* was depoſited on a human tooth.

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* Tab. iii. Fig. 4. c.

† Tab. iii. Fig. 4. a. b.

‡ Tab. iii. Fig. 6. a.

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* Tab. iii. Fig. 5. a. b.

† Tab. iii. Fig. 7. a.

With reſpect to the uncommon ſituation of the teeth in the jaw, by far the moſt curious caſe is related by Albinus of an adult in whom he found " Two teeth, one on each ſide of the " noſe between it and the orbits of the eyes, " encloſed in the roots of thoſe proceſſes, " which extend from the maxillary bones " to the eminence of the noſe. They were " long and remarkably thick, ſimilar to the " canine teeth and ſeem to have been theſe " very teeth which had not in this caſe appeared. But there were, beſides theſe, other " canine teeth, unuſually ſmall and ſhort, placed in their proper ſockets. The former " ſeem therefore to have been the new canini " which had not penetrated their ſockets, on " the contrary they were ſituate where the " new ones uſually are obſerved to be in children.

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* Tab. iii. Fig. 7 and 8. b. b.

" dren. But what is ſtill more ſtrange, the
" points of their bodies were turned towards
" the eyes, as if they had been the new ca-
" nine teeth inverted, convex on the poſterior
" part, concave on the anterior, the reverſe of
" what generally happens *."

This caſe fully ſhews the great accuracy of Albinus, he did not miſtake thoſe ſingularly ſituated canini for ſupernumerary teeth though he was aware that ſuch frequently occur.

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* " Dentes duo inter naſum et orbes oculorum,
" dexter ſiniſterque, incluſi in radicibus proceſſuum, qui-
" bus oſſa maxillaria ad eminentem naſum pertinent.—
" Longi ſunt, craſſitudinis inſignis ; ſimiles maxime ca-
" ninis, ut videri poſſint illi ipſi eſſe, non nati. At ade-
" rant præterea canini, præter conſuetudinem parvi, et
" breves, ſuis infixi alveolis. Itaque videantur eſſe canini
" novi, qui non eruperint : utpote ibi loci collocati, ubi
" ſunt novi illi in infantibus Sed, quod miremur, ſurſum
" directi, tanquam ſi ſint canini novi inverſi. Et ita quo-
" que formati ſunt, ut, contra quam alii, à poſteriore par-
" te gibbi, ab anteriore ſinuati ſint, &c." Acad. Annotat.
Lib. 1. Pag. 54.

Mr. Hunter mentions his having met with a caſe ſomewhat ſimilar, and gives* "a "ſketch of the upper jaw of a child, where the "*cuſpidatus* was inverted, ſo that its point "was turned up againſt the jaw, and the "growing mouth of its cavity towards the "gum."

Amongſt the temporary teeth ſupernumerary ones are ſeldom obſerved. Dr. Hudſon however has met with a few inſtances of this kind; they are much more frequently found amongſt the permanent teeth, and eſpecially in the upper jaw. Their ſhape in general reſembles the Cuſpidati. He further obſerves, "They "are not confined to the front of the mouth. "I have found them in every part of the jaw, "between the middle *Inciſores*, between the "middle and lateral, between the lateral and "*Cuſpidati*, &c. among the large Grinders, "on the outſide or inſide of them, and in the "palate. I have alſo ten or twelve times "found teeth beyond the *dentes ſapientiæ ſu-*

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[*] Nat. Hiſt. explanat. of Tab. viii. Fig. 9.

" *periores.* They were all ſmall, the enamel-
" led part ſhaped like the adult Grinders, but
" never with more than one fang. I call them
" *ſecond wiſdom teeth*, and always compliment
" my patient on the probability of poſſeſſing a
" double portion of ſagacity."

How ſupernumerary teeth are formed we can eaſily conceive, but how teeth could be inverted as Albinus and Mr. Hunter have ſhewn, is much more difficult to be accounted for. I have ſometimes obſerved a ſupernumerary tooth, firmly attached to a Grinder; Fauchard has noticed ſimilar appearances and alſo mentions his having met with two Grinders joined together, and a ſupernumerary tooth likewiſe connected with them *. However I do not think it neceſſary to dwell on this ſubject, particularly as it is a ſubject of curioſity more than of importance.

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* Tom. 11. Planche 27. Fig. 16.

CHAPTER X.

Of the Veſſels and Nerves of the Teeth.

HAVING repeatedly injected and examined the jaws of young ſubjects, I obſerved blood veſſels paſſing from the gum to the membranes deſtined to form the cortex ſtriatus.—It was natural enough then to conclude, that, as the inveſting membranes were derived from the gum, their nouriſhment too did originate from the ſame ſource, and that the uſe of the veſſels which entered the proper *foramina* of the jaws, was only to form the pulp and bony part of the tooth. Further conſideration of the ſubject however urged me to relinquiſh this opinion: it would by no means hold good on comparing it with what takes place in the jaws of large animals, for (as mentioned in chapter eight, page 83) the cortex ſtriatus continues to be formed on the external plates of their teeth even after the upper part of them has appeared through the gum.

As frequent opportunity occurred in the courſe of this eſſay to mention the veſſels and nerves of the teeth, I would not have allotted them a diſtinct chapter, were it not that Mr. Hunter aſſerts that the teeth are nearly inorganic, and alſo that "we can actually tranſ-"plant a tooth from one perſon to another *." Although tranſplanting teeth was for ſome time practiſed, yet the dreadful conſequences which ſo frequently enſued, as well as the bad ſucceſs which commonly attended this operation, induced its moſt ſtrenuous advocates (I truſt for ever) to lay it aſide.

Mr. Hunter in ſupport of his doctrine aſſerts "He could never trace the nerves diſtinct-"ly even to the beginning of the cavity †." Yet Euſtachius ſeems to have been much more fortunate in his diſſections of man as well as other animals, which appears from the following quotation: "When we paſs from the

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[*] Nat. hiſt. page 38 and 126. See alſo part 2d. page 94. 95, &c.

[†] Nat. hiſt. page 42.

“ Grinders to the ſmall teeth, the nerve with
“ its concomitant artery is divided into two
“ branches, one of which paſſes out through
“ the hole in the jaw near the lower lip; the
“ other branch proceeds on to the roots of
“ the Inciſores and ſends to each a twig, one
“ portion of which is expanded on the exter-
“ nal membrane of the root, but the other
“ and that the moſt delicate paſſes into the
“ internal cavity. This fact indeed can be
“ eaſily obſerved even in the human body by
“ thoſe who are engaged in accurate diſſecti-
“ ons. But it is truly wonderful and ſeems
“ almoſt inconſiſtent with the laws of nature,
“ that the Inciſores and Canine teeth, which
“ are ſmall and have only one root, poſſeſs
“ large and conſpicuous branches of nerves
“ and veſſels, whilſt the Grinders, which are
“ much larger and have three and ſometimes
“ four roots, are ſupplied by branches proceed-
“ ing to each root nearly as ſmall as hairs *.”

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* “ Poſtquam vero a molaribus ad minores dentes
“ deſcenſum eſt, nervus cum arteria, quæ illum comi-
“ tatur, bipartito ſcinditur, cujus pars úna per foramen
“ eo loco ſculptum, ad labium inferius emergit; altera
“ ad

Doctor Monro has ſeveral preparations in his Muſeum, in which the nerves and veſſels were traced by him into the roots of the teeth, and alſo into the pulp, which appears ſufficiently evident in Tab. i. Fig. 4. g. &c.

Mr. Hunter obſerves,[*] “ A ſtrong circum- “ ſtance in ſupport of the teeth having no “ circulation in them, is that they never “ change

“ change

“ ad radices Inciſorum tendit, diſtributoque cuique “ ipſorum ſurculo, una portione ſui cum exteriore radi- “ cum parte jungitur ; altera autem, eaque tenuiſſima, “ ſinum dentium penetrat ; quod quidem etiam in ho- “ mine ab his qui ſectionem docte et accurate tractant, “ cerni non difficulter poteſt. Sed mirum profecto eſt, “ et naturæ æquitati parum decens videtur, Inciſores “ et Caninos dentes, parvos, unaque radice infixos, “ ejuſmodi nervorum ac vaſorum ſurculos magnos et “ conſpicuos obtinere, patentique via ad inſertionem “ accedere : Molares vero, eis longe majores, tribuſque “ et interdum etiam quatuor radicibus præditos, eoſdem “ ſurculos, qui bifariam, trifariamve, ac etiam quadri- “ fariam ſcindi debent, capillorum modo tenues habere, “ obſcuriſſimoque itinere incedére.” Opuſcul. de dentib. page 63.

[*] Nat. hiſt. page 39.

" change by age, and ſeem never to undergo " any alteration, when completely formed, " but by abraſion ; they do not grow ſofter, " like the other bones, as we find in ſome " caſes, where the whole earthy matter of the " bones has been taken into the conſtitution. " From the foregoing experiments it would " ſeem that the teeth are without abſorbents " as well as other veſſels, and are to be conſi- " dered as extraneous bodies, with reſpect to " a circulation through their ſubſtance."— Theſe remarks of Mr. Hunter's are by no means juſt, for the bony part of a tooth undergoes changes by age, as well as any other part of the body. Indeed if by chance the veſſels which enter the roots and are diſtributed on the pulp be torn, or deſtroyed, the body of the tooth becomes diſcoloured, ſometimes nearly black, the external membrane which ſurrounds the roots not being ſufficient to ſupply it with nouriſhment, ſo that the bony part acts as a foil to the cortex ſtriatus. I have frequently obſerved their roots changed nearly to a cartilaginous ſubſtance and rendered perfectly tranſparent by the abſorption of the bony matter. The roots of the Grinders have been ſo frequently obſerved joined together by exoſtoſis, that its occurrence was well known to Euſtachius, nay even to Hippocrates *. However an inconteſtable proof of the preſence of veſſels both circulatory and abſorbent and conſequently of nerves, may be deduced from the progreſſive or continued growth of the Inciſores in the ſquirrel tribe, and the colouring of the teeth of all animals from feeding on food mixed with madder, and the ſubſequent loſs of the acquired colour from diſcontinuing the uſe of madder: this circumſtance ſhall be referred to in the next Chapter.

In one of my preparations I obſerved that the artery and nerve ſeparated, ſoon after their entrance into the common foramen of the jaw, the artery paſſing in a diſtinct groove near the roots of the teeth, and ſending off a ſmall branch in the courſe of the nerve to nouriſh it, ſo that in this caſe they could not impede each others action †.

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* Opuſcul. De Dentib. page 97. † Tab. i. Fig. 7.

CHAPTER XI.

Of the Cortex Striatus.

I HAVE frequently demonſtrated in the courſe of this eſſay, that (in all the animals we have been examining, as well as man) the earthy matter of the *cortex ſtriatus* was at firſt depoſited by the inveſting membrane, in a ſoft and moiſt ſtate, on the external bony lamella of a tooth. In this condition, when allowed to dry on the human tooth, it cracks, it aſſumes a yellowiſh white colour, adheres to the tongue, feels rough and ſtains the fingers ſlightly when rubbed between them. It continues ſeemingly without any change of texture until it has acquired its full degree of thickneſs, when the veſſels of the inveſting membrane aſſume a different mode of action, from what they had hitherto done and probably pour out a fluid, which diſpoſes the earthy particles to arrange in ſuch order, as by virtue of their mutual attraction to form themſelves into fibres of an angular ſhape, from whoſe appoſition ariſes a maſs of a determinate figure, the ſurface of which becomes white, ſhining, hard and beautifully poliſhed.

On breaking a perfect tooth, we obſerve the cortex ſtriatus compoſed of innumerable fibres, diſpoſed upon the bony part of the tooth in the ſame manner as thoſe of the articular cartilages over the extremity of the bone in the joint of the thigh, or any of the other very moveable joints; or they are cryſtalliſed exactly in a ſimilar manner to the ſtriated ſnow white zinc ſpar of Mr. Kirwan *. Theſe fibres are firſt formed or cryſtalliſed on the points or edges of the tooth, and they proceed very ſlowly range after range towards the neck where they terminate.

The accuracy of Mr. De la Hire's obſervations, reſpecting the arrangement of the fibres of the cortex ſtriatus upon the body of the

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* Tab. iv. Fig. 20. 21. &c. See alſo Kirwan's mineralogy. Vol. II. page 236.

tooth, juſtifies their inſertion. He ſays, “ It is compoſed of numberleſs ſmall fibres, which are attached to the internal part of the tooth by their roots, nearly as the nails and horns are to the parts with which they are connected. We can ſee without difficulty this ſtructure when a tooth is broken, and we obſerve that the fibres which ariſe from that part of the tooth next the gum, are there very much inclined, but they are placed perpendicular on its baſe; by which means they reſiſt in a greater degree without injury the actions to which they are expoſed *.

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* “ Qu'elle eſt compoſée d'une infinité de petits filets, qui ſont attachez ſur la partie interne de la dent par leurs racines, à peu près come les ongles et les cornes le ſont aux parties où elles ſ'attachent. On voit très facilement, cette compoſition dans une dent rompuë, où l'on remarque que tous ces filets, qui prennent leur origine vers la partie de la dent qui touche la gencive, ſont fort inclinez à cette partie, et preſque perpendiculaires ſur la baſe de la dent : par ce moyen ces filets réſiſtent davantage à l'effort qu'ils ſont obligez de faire en cet endroit.” Mathém. et memb. de l'Acad. Roy. des Sciences. Mém. de l'Acad. de 1699.

Many authors ſuppoſe that after the tooth has appeared through the gum, the cortex ſtriatus continues to increaſe in thickneſs and hardneſs, and that it becomes more and more perfect and beautiful until a certain period of life, at which period *only* it begins to wear away. Fauchard ſays, “ This ſubſtance which we call “ the enamel, is formed previous to the ap-“ pearance of the tooth, but it ſtrengthens and “ becomes more beautiful, until the age of “ twenty years or thereabout; after which “ period it begins to wear away by the con-“ tinual friction *.” The many obſervations however already made on the cortex ſtriatus, and alſo thoſe which are immediately to follow, will induce us to form a very different opinion from Fauchard and others.

I have ſhewn in chapter iv. page 35, that Mr. Hunter's theory reſpecting the formation of the cortex ſtriatus is not juſt, for he ſuppoſed that it was formed both by a pulp and capſula. Now the cortex ſtriatus according to my obſervations is depoſited and formed by a membrane alone, and I have repeatedly mentioned that when it aſſumed the cryſtalline form the membrane was waſted. It has been alſo demonſtrated in the human tooth, as well as in thoſe of animals, that, even where the inveſting membrane was not waſted, the cortex ſtriatus once formed did not receive the slighteſt accretion of a ſimilar ſubſtance, but that the membrane aſſumed a different mode of action and depoſited a cruſta petroſa on its ſurface, as is ſo generally obſerved in graminivorous animals *. From thence and many other obſervations and experiments, I conclude, that, when once a tooth penetrates the gum, the cortex ſtriatus is then as hard and perfect on it, as it can be at any future period of life, nor does it even after that period receive the ſlighteſt degree of nutrition ; indeed it does not ſeem to require it, for I have frequently ob-

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* “ Cette ſubſtance que l'on nomme émail, ſe forme “ avant la ſortie de la dent, ſe fortifie et ſ'embellit “ juſqu' à l'âge d'inviron vingt ans ; après lequel tems “ cet émail commence à ſ'uſer par le frotement conti-“ nuel.” Le Chirurgien dentiſte, Tom. i. pag. 24.

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* Tab. iii. Fig. 7 and 8. b. b.

ſerved in old church yards the cortex ſtriatus quite perfect, although the bony part had entirely mouldered to duſt. The appearance of the cortex ſtriatus however is much influenced by the ſtate of the bony part underneath, the colour of which in a certain degree it partakes of, ſo that it ſeems to improve until a certain period of life, though in reality it does not; and as I juſt now mentioned it does not increaſe either in thickneſs or hardneſs, after it has appeared through the gum.

The cortex ſtriatus is perfectly formed, in a much ſhorter ſpace of time, on ſome teeth than on others; the ſlow progreſs of it however does not ſeem to have much influence with reſpect to its perfection, for, it is frequently obſerved more perfect and beautiful on thoſe teeth which require only twelve or fourteen months for their formation, than on thoſe which require as many years, ſcil. the temporary Inciſores and wiſdom teeth. In general it ſeems to require about ſix or eight years, from the time it commences to cryſtalliſe on the points of the permanent teeth, until it is perfectly formed around their bodies.

From the foregoing obſervations we can readily underſtand, how defects, or derangements in the conſtitution, or the many changes which take place in it, during the periods we have mentioned, may at times totally impede the formation of the cortex ſtriatus, or render it ſuſceptible of various ſtages or degrees of perfection. Now as the correſponding teeth in both jaws (for example the anterior permanent Grinders) are formed at the ſame time, if there ſhould have been any derangement in the ſyſtem during the period of their formation, we find their cortex ſtriatus imperfectly formed and of courſe the foundation of their decay laid. But as a conſiderable period elapſes between their formation and that of the middle Grinders, the conſtitution often acquires ſuch vigour in this interval, that the middle ones are frequently obſerved perfect, whilſt the anterior are rotten.

I have many times met with teeth on whoſe points or edges the cortex ſtraitus was perfectly formed, but immediately under the perfect fibres, it became imperfectly cryſtalliſed, of a yellowiſh colour and remarkably indented or pitted. Theſe pits frequently extend over a great portion of the body of the tooth and the cortex ſtriatus becomes again perfect towards the neck; they are uſually ſituated on the upper ſurface and ſides of a Grinder particularly at the junction of the ſhells *.

There is a permanent Inciſor amongſt my preparations, the upper part of the cortex ſtriatus on the body of which was imperfectly formed, being ſoft, pitted, and of a dark brown colour; a few perfect fibres however were formed near the neck, and inſtead of the pulp contracting at this part as it uſually does, it extended conſiderably beyond the body of it, as if nature endeavoured at this period to form it anew †.

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* Tab. iv. Fig. 6. a. and Fig. 30. a. a.

† Tab. iii. Fig. 10. a. b. c.

An ingenious Surgeon Dentiſt of Liverpool (Mr. Wooffendale) in endeavouring to account for theſe pits, makes uſe of the following obſervations *. “ I have been at ſome “ pains, and I believe my endeavours have “ not been in vain, to aſcertain a cauſe for “ theſe appearances,” which he entirely attributes to the ſmall pox, but when his theory begins to fail he ſays “ I have frequently ſeen “ theſe marks on both the firſt and ſecond ſets “ of teeth, which cauſes me to ſuſpect ſuch “ children have had the ſmall pox twice.”

In moſt of the caſes I have juſt now mentioned, there ſeems to have been ſome defect in the conſtitution, with reſpect to depoſiting the oſſific matter at certain periods ; but in other caſes and thoſe which are by far the moſt frequent, there ſeems to have been a want of that particular change which diſpoſes the earthy particles to cryſtalliſe. Many times have I ſeen the anterior permanent

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* Obſervations on the teeth, page 34 and 35.

Grinders as ſoon as they appeared through the gum, with almoſt the entire earthy matter of their cortex ſtriatus perfectly ſoft and opake; moſt commonly however it remains ſoft at the interſtices or junction of their ſhells, and at the termination of the cortex ſtriatus on the neck of the tooth. I have alſo frequently obſerved a thin hard ſcale of the cortex ſtriatus on the ſurface of a Grinder, which being broken by ſome accident, the internal part of it appeared quite ſoft; ſimilar appearances (though leſs frequent) I have obſerved on all the teeth. But in the different tribes of animals we have been examining, ſome of whoſe teeth are formed in a much ſhorter ſpace of time than the human, I have not as yet ſeen a ſingle inſtance where the cortex ſtriatus was imperfectly formed.

Although a variety of experiments have been made on young animals, in which their bones were deeply tinged of a red colour, by mixing madder with their food, I do not think any of them as yet prove, that the colouring matter was equally communicated to the cortex ſtriatus. Mr. Hunter ſays *, " In all " theſe experiments I never could obſerve, " that the enamel was in the leaſt tinged, ei- " ther in the growing or formed tooth.— " This looks as if the enamel were the earth " more fully depurated or ſtrained off from " the common juices in ſuch a manner, as not " to allow the groſs particles of madder " to paſs."

Other Phyſiologiſts however aſſert the very reverſe ; and I have frequently ſeen teeth the cortex ſtriatus of which was ſaid to be highly tinged by the animal feeding on food mixed with madder, but on carefully examining them, I found, that the external ſurface only was highly ſtained by grinding the food, for, when broken acroſs, the internal part of the cortex ſtriatus was ſcarcely tinged, and alſo the external colour was eaſily waſhed off.— I have however a very beautiful ſpecimen of the Grinder of a young pig which had not appeared through the gum, the bony part of which is tinged of a moſt brilliant red colour,

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* Nat. Hiſt. page 35.

but the cortex ſtriatus although tinged is but ſlightly ſo in compariſon with the bony part.

Mr. Hunter's experiments and obſervations on this ſubject, I have now ſhown are not juſt, particularly where he ſays " the enamel takes no tinge from feeding with madder, even in the youngeſt animals."

To aſcertain whether the cortex ſtriatus would take as deep a tinge as the bony part, I inſtituted the following experiment, which did not altogether anſwer my expectation; however it eſtabliſhes one fact, viz. " that the colouring matter of madder can be communicated to the *fœtus in utero*." I procured a female rabbit three or four days after pregnancy, and fed her regularly on food mixed with madder; about twenty-eight days after ſhe brought forth ſix young ones; one of theſe I immediately deprived of life, and found its bones ſlightly tinged of a red colour. Another of them being ſuckled by the mother for about twenty days, was then deprived of life, its bones were much more deeply tinged than the bones of the firſt. The bones of a third being fed on the food mixed with madder, for ten or twelve days after, were much more brilliantly tinged than any of the former. The teeth of all theſe animals were tinged, but whether the cortex ſtriatus was equally ſtained with the bone, or whether the colour of the bone ſhone through the cortex ſtriatus (which in the rabbit is remarkably thin) I cannot poſitively affirm.

At preſent however I am conducting a ſimilar experiment on a pig, in order to aſcertain this point, as well as many others : the cortex ſtriatus being much thicker on this animal's teeth than on the former, and alſo being much more eaſily fed : the *progreſs of which* I intend to make public.

Doctor Rutherford in his lectures on Botany when ſpeaking of madder, introduced ſome beautiful and intereſting experiments he had made on this ſubject, extracts from which he was kind enough to allow me to inſert.— He ſays, " It has been long known that if " madder be mixed with the food of living " animals, their bones preſently acquire a red " colour. This was accidentally firſt diſco- " vered in ſome hogs which had been fed in " a dyer's yard upon bran that had previ- " ouſly been employed to diſcharge the looſe " and ſuperfluous colouring matter from cal- " lico or cotton cloth recently dyed with mad- " der.

" In theſe the bones were quite of a full " red, while the cartilages and the meat, fat; " in general all the ſoft parts had no particu- " lar tinge, or remained entirely of the uſual " appearance. A fact ſo unexpected imme- " diately attracted the attention of the ob- " ſerver Mr. Belchier: and many experiments " were made by him and by M. Du Hamel, " to inveſtigate the ſubject. It ſoon appear- " ed, that only the proper bony part received " the tinge,—the ſoft parts, even the gelati- " nous and cartilaginous matters, in which

" the bones themſelves were formed, remaining untinged, when the proper bony fibres " had already acquired a deed red colour.— " That the younger the animal was, the more " quickly was the change produced : in a " young pigeon ſome change was obſerved " within twenty-four hours, and within three " days all the bones were of a ſcarlet colour. " That the bones were unequally tinged, the " harder the more deeply, the middle therefore of the long bones, and the bony part " of the teeth (although the enamel remained " quite white) the moſt deeply of all. Sometimes however irregularly even in young " animals, ſpots appearing in them much " deeper than the general tint of the whole, " in old animals, again ſeveral faint ſpots " often appeared on a darker ground : or even " ſpots of different colours or hues,—that " by diſcontinuing the uſe of the madder, the " red colour gradually diſappeared or was " diſcharged and the bones re-aſſumed their " natural appearance.

" Subſequent experiments have ſhewn that " the fluids are alſo tinged by madder, the " ſerum and milk eſpecially. M. Du Hamel " immediately concluded that it was the nu" tritious matter of the bone, only, which " conveyed the colouring matter; and others, " following his idea, have juſtly obſerved, " that this is depoſited along with the earth " of the bone. But how this comes to paſs, " why the bones receive a much deeper tinge, " than any other parts of the body, has not, " ſo far as I know, as yet been ſatisfactorily " explained. Though M. Du Hamel ap" proached nearly the true explanation, " when he illuſtrated the ſubject by the phœ" nomena obſerved in dyeing cloth with " madder.

" We have in the fact before us, a beauti" ful example of a particular caſe of chemical " attraction; ſuch as, in numberleſs inſtances, " is obſerved to take place betwixt the colour" ing particles of both animal and vegetable " ſubſtances and various other bodies; eſpe" cially earths or earthy ſalts, and oxydes of

" metals. So ſtrong is the affinity of the co-
" louring matter to theſe bodies, that it is fre-
" quently obſerved to quit the menſtruum in
" which it may chance to be diſſolved, to
" unite with them; they, in conſequence of
" its union, acquiring a particular tinge, while
" the menſtruum is proportionally deprived
" of colour. Or, when both happen to be
" diſſolved in the ſame menſtruum, if, by any
" means, theſe bodies are diſengaged, become
" inſoluble in the menſtruum, and are precipi-
" tated from it, the colouring matter likewiſe
" falls down along with them, or in combina-
" tion with them. From this principle, this
" mutual attraction, is deduced the various
" uſe of theſe bodies, as mordents, as they are
" called, intermedia, or means for fixing the
" colours in dyeing, and ſtaining thread, or
" cloth, whether it be compoſed of animal or
" vegetable materials.

" It is often to be obſerved that the colour-
" ing matters, which are commonly employ-
" ed as dye ſtuffs, have hardly any conſpicu-
" ous affinity with pure animal or vegetable

" fibres, and that, though they ſeem to com-
" municate a conſiderable tinge to theſe fibres,
" yet the colour adheres only ſlightly to their
" ſurface, ſo that it can eaſily be waſhed or
" rubbed off again, thus leaving theſe fibres
" very nearly of their original complexion.
" But if the fibres be previouſly impregnated
" with a proper mordent, by the interpoſition
" of this, and in conſequence of the mutual
" affinity that ſubſiſts, both betwixt it and
" the colouring matters, and likewiſe betwixt
" it and the fibres, the colouring matter now
" attaches itſelf ſo ſtrongly to theſe fibres, that
" they ſeem to become incorporated altoge-
" ther, and the colour communicated to the
" fibres is proportionally fixed and durable;
" and reſiſts, unchanged, the action of vari-
" ous ſubſtances, by the application of which,
" it would have been otherwiſe greatly alter-
" ed, or perhaps entirely diſcharged.

" Upon the ſame principle depends the
" preparation of thoſe pigments, known to
" painters by the name of Lakes. Theſe are
" truly precipitates of the colouring matter, in

“ combination with various mordents as their
“ baſes. They are prepared by mixing to-
“ gether ſolutions of the mordent and colour-
“ ing material; or diſſolving both in the ſame
“ menſtruum, and adding, if need be, ſuch
“ ſubſtances as ſhall effectuate their precipita-
“ tion, or cauſe their ſeparation from the
“ menſtruum. The colour of the lake may
“ frequently be changed at pleaſure even while
“ the ſame colouring material is employed,
“ viz. by uſing different mordents, as the co-
“ lour is influenced by the nature of the par-
“ ticular mordent that is uſed, and the peculiar
“ chemical action this may have upon the
“ colouring matter.

“ The colouring of the bones of a living
“ animal, by the uſe of madder, is in every
“ circumſtance analogous to the preparation
“ of theſe lakes. The colouring matter of
“ the madder, paſſing unaltered through the
“ digeſtive organs of the animal, enters the
“ general maſs of fluids, and is diſſolved in
“ the ſerum of the blood; to which, indeed,
“ if it be in large proportion, it communicates

" a very ſenſibly red tinge. But there is always preſent in the blood, and in a ſtate of ſolution in the ſerum, a quantity of the earthy matter of the bones, phoſphate of lime, ready to be depoſited, as the exigencies of the animal ſhall require. Now, the phoſphate of lime is an excellent mordent to madder, has a ſtrong affinity to it, and conſequently is admirably fitted to afford a baſe to the colouring matter of it, and thus forms a lake. This is what actually takes place, whenever, in ſuch circumſtances, by a peculiar animal proceſs, the matter (which probably ſerves to keep the phoſphate in ſolution) being withdrawn, this concretes within the cellular texture, into the fibrous and ſolid matter of the bones: for at the inſtant of its loſing its ſolubility, it powerfully attracts and combines with the colouring matter of the madder, that is preſent in the ſerum, communicating inſolubility alſo to this colouring matter and hence they both concrete together into a homogeneous maſs, not white or colourleſs, as the pure earth of bones

" uſually is, but tinged of a full crimſon or
" carmine colour.

" That this is actually the caſe may be
" ſhewn by various experiments. Thus, if
" to an infuſion of madder, in diſtilled water,
" be added a little of the muriate of lime, no
" change is perceived ; but if to this mixture
" be added a ſolution of the phoſphate of ſoda,
" immediately a double elective attraction
" takes place : The muriatic acid, combining
" with the ſoda, remains ſuſpended or diſſolved
" in the water ; while the phoſphoric acid,
" thus deprived of its ſoda, combines with the
" lime, which the muriatic acid had parted
" with, and forms phoſphate of lime, or earth
" of bones. This ſubſtance being, however,
" inſoluble in water, falls to the bottom : but
" having combined, at the inſtant of its formation,
" with the colouring matter of the
" madder, they fall down united into a crimſon
" lake, preciſely of the ſame tint with that
" of bones, of young animals, which have
" been fed with madder.

" From this ſimple repreſentation of the
" matter, we have a ready explication of every circumſtance that has been remarked as
" extraordinary reſpecting this ſubject.

" Why *e. g.* the bones of young animals
" ſhould be more quickly, and more deeply
" tinged than the bones of older animals.—
" Becauſe there is a more rapid depoſition and
" alſo more rapid change of earthy matter in
" the bones of young animals—though probably the earthy matter as it is depoſited,
" is equally deeply tinged in old as in young
" animals, yet, in the latter, the colour of it is
" leſs diluted by the intermixture of particles,
" which had concreted before the commencement of the experiment, and were conſequently of the natural or white colour.—
" Why the harder parts of the bones are moſt
" deeply tinged—becauſe a greater number
" of coloured particles are compacted into the
" ſame ſpace.—Why ſometimes a bone ſeems
" mottled or ſpotted—becauſe, there had, probably, been ſome topical irregularity, reſpecting either the ſecretion of freſh bony

" matter, or abſorption of what had formerly " been depoſited.—Why the bones acquire a " very deep tinge, when perhaps the ſerum " of the blood has not acquired any ſenſible " colour from the madder—Becauſe the " fluids being in conſtant motion and the " earthy matter being depoſited very ſlowly " the naſcent bone being continually waſhed " and for a conſiderable length of time by the " ſtream of ſerum, it attracts and combines " with the colouring matter of all the ſerum, " with which it chances to be waſhed, while " it is in the act of concretion. Hence like- " wiſe appears, why the gelatinous and ſoft " matters in which the bone itſelf forms ſhould " have no tinge, though the bony fibres ac- " quire a very deep one; for even were theſe " matters compoſed chiefly of the matter of " bone, ſtill this muſt be in a ſtate of ſolution " and in that ſtate it cannot attract or cauſe " any accumulation of the colouring matter " or ſeparation from the fluid in which it is " diſſolved.—Why the enamel of the teeth " receives no colour—becauſe in fact there is " no change in that ſubſtance, with reſpect

" to either ſecretion or abſorption after it is
" once formed.

" But it by no means follows, that the enamel of the teeth may not acquire a tinge, in
" the ſame manner as the earth of bones, provided that the fluids of the body were ſufficiently loaded with the colouring matter of
" madder, or other ſuch tinging material, at
" the time that the enamel is ſecreted, or firſt
" aſſumes a concrete form ; as in young animals while their teeth are juſt in a naſcent
" or incipient ſtate ; or perhaps ſtill better, in
" the fœtus in utero, viz. by mixing the tinging materials plentifully with the food of the
" mother during her geſtation.

" But even though the enamel ſhould acquire a tinge in ſuch trials ; it may well be,
" that this tinge ſhall be very different from
" that acquired at the ſame time by the bones :
" For as the ſtructure and compoſition of the
" enamel is different from thoſe of the fibrous
" or earthy part of the bones, it is likely that it
" may have a different effect in modifying the
" colouring

" colouring matter of madder; both with reſ-" pect to the particular tint or ſpecies of co-" lour, and the particular ſhade or intenſity of " it: Juſt as we find, that with the ſame co-" loured infuſion, by employing different " mordents or baſes, various lakes may be ob-" tained differing from one another in colour, " both in ſpecies and degree.

" The ſame obſervations may be made " concerning the concreting particles of many " other ſolids of the body. Thoſe of the " different ſolids may receive at the ſame " time, each, according to its particular nature, " a different hue. Or perhaps having no par-" ticular affinity with the colouring matter of " madder, incapable therefore of acting as a " mordent to it, may receive not the ſlighteſt " tinge from it. It is to be underſtood that the " ſolids here alluded to are thoſe only which " derive the firmneſs of their texture from the " chemical concretion of particles depoſited in " them from the general maſs of fluids. Theſe " particles muſt therefore be conſidered as ab-" ſolutely lifeleſs and inert, poſſeſſed of no qua-

" lities whatever but ſuch as are competent to
" any inanimate matter. It is with theſe
" particles only that the colouring matter
" combines. Theſe then are the only parts of
" an animal body which can be tinged or co-
" loured by the uſe of madder or any other
" ſuch material. Hence it is not to be ex-
" pected, that the living ſolids of the body,
" *e. g.* the brain or nerves, ſhould ever receive
" the ſlighteſt tinge in ſuch experiments, or
" even thoſe that are formed by the coagula-
" tion of the coagulable parts contained in
" the fluids of the body.

" It is natural to ſuppoſe, that there may be
" many vegetable ſubſtances, which like the
" roots of madder, are poſſeſſed of the quality
" of communicating a particular colour to the
" bones of living animals: all that is required
" for producing this effect, is, that the colour-
" ing matter of theſe ſubſtances ſhould be of
" ſuch a nature, that it ſhall not be altered by
" the digeſtive powers of the ſtomach, ſhall
" enter the maſs of fluids and be diſſoluble in
" the ſerum of the blood, and that it ſhall

" have a ſtrong chemical affinity with the " earth of bones. Then we may reaſonably " conclude, that by the uſe of ſuch ſubſtance, " the bones will acquire the particular colour " the ſubſtance employed uſually gives to " other bodies, and we attain to almoſt abſo- " lute certainty in this matter, by ſuch an ex- " periment as that formerly taken notice of.— " Several ſuch ſubſtances have already been " diſcovered and their power aſcertained, by " direct experiments upon living animals *e. g.* " the roots of ſeveral ſpecies of the *galium*, " *aſperula* and other plants of the ſame natural " order with the rubia, all thoſe like the ru- " bia itſelf, give a red colour to the bones.— " But there are probably, many others, hi- " therto unaſcertained which would give very " different colours: or at leaſt very different " tints of red. Many plants are known to " give a red colour to the urine, *e. g.* Beet " root, fruit of the *opuntia* or Indian fig; " many more communicate a yellow tinge to " the urine, and ſometimes a tinge of great " brilliancy. A ſingle doſe of the root of " rhubarb will frequently render the urine

" of a gold colour. There can be little
" doubt that by the continued uſe of ſuch
" plants, the bones would alſo acquire a bright
" yellow colour. Perhaps ſome plants may
" be found abounding with a blue juice, of
" ſuch chemical qualities, as to enable it to
" tinge the bones of living animals of a blue
" colour : an example indeed does not occur
" of one exactly fitted for this purpoſe, ex-
" cept perhaps the *genipa americana*, the
" pulp ſurrounding the ſeeds of which, is ſaid
" to ſtain animal matters of an indelible blue :
" and this might perhaps reſiſt the digeſtive
" proceſſes going on in the ſtomach, and in
" this caſe would probably give a blue colour
" to the bones. The juices or rhinds of
" ſome other purple fruits may be poſſeſſed
" of ſuch qualities, as ſeveral appear to paſs
" through the inteſtinal canal without having
" undergone a very great change in reſpect
" of their colour."

I mentioned in my theſis (page 126) that the cortex ſtriatus differed materially in its chemical qualities from the bony part of a tooth, being chiefly the carbonate of lime, but did not introduce the few experiments I had an opportunity of making on it, thinking them by no means concluſive: I ſhall now however mention thoſe which induced me to form this opinion. Experiment 1. I found that the cortex ſtriatus was entirely ſoluble with efferveſcence in dilute nitric or muriatic acids. Ex. 2. When ſome of it was expoſed to a heat of about 20 of Wedgewood for 25 minutes, it was reduced to a remarkably white powder; on throwing part of this into diſtilled water a hiſſing noiſe was heard, and on adding a few drops of muriatic acid to it, a much ſlighter effervеſcence took place, than where the freſh cortex ſtriatus had been made uſe of. This ſubject, however, has been ſince proſecuted with much greater judgment and accuracy by the truly ſcientific analyſt Mr. Charles Hatchett, and he was ſo very obliging as to repeat before me the experiments he had made on it, which were publiſhed in the Philoſophical Tranſactions for the year 1799 *.

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* See Mr. Home's Obſervations, &c. Page 9 and 10.

By theſe I was at once convinced of the error I had fallen into, for although the cortex ſtriatus contains a certain proportion of the carbonate of lime, it is chiefly compoſed of the phoſphate; the preciſe proportions however have not been as yet aſcertained, Mr. Hatchett's time not permitting him to make a complete analyſis, his experiments are as follows: Experiment 1. " Some enamel, raſped " into a fine powder, was put into a matraſs, " and, pure muriatic acid being added, the " whole was ſuffered to remain without the " application of heat during one hour ; in the " courſe of this time, the enamel was com- " pletely diſſolved with a gentle efferveſ- " cence.

" To this ſolution, ſome ſulphuric acid was " gradually added, till all precipitation had " ceaſed : The precipitate was ſeparated by " a filter, and was found to be ſelenite. The " filtrated liquor, by evaporation, afforded a " ſmall additional quantity of ſelenite, which " was alſo ſeparated ; after which, the liquor " being evaporated became thick and viſcid.

" This, when diluted with water, precipitated " lime from lime water, in the ſtate of phoſphate.

" To another portion, ſolution of acetite of " lead was added, and cauſed an immediate " precipitation of a white matter, which when " dried and ſprinkled on burning charcoal, " produced a light and ſmell like phoſphorus; it moreover, was ſoluble in nitrous " acid and was thus to be diſtinguiſhed from " muriate or ſulphate of lead.

Experiment 2. " Some of the raſpings of " enamel were diſſolved by digeſtion in nitric " acid, and, when the ſolution had been diluted and filtrated, it was ſaturated with " carbonate of ammoniac. The precipitate " thus produced was collected and edulcorated in a filter. The ſmall exceſs of carbonate of ammoniac, in the filtrated liquor, " was ſaturated with acetous acid; after " which, the phoſphoric acid was precipitated, " by ſolution of acetite of lead. Upon examining the firſt precipitate, or that produc-

" ed by the carbonate of ammoniac, it was " ſound (contrary to expectation) that it was " ſtill compoſed of lime, combined with a " portion of phoſphoric acid, inſtead of car" bonic acid, which might have been ſup" poſed.

" To effect, therefore, a complete ſepara" tion of the two ingredients, (lime and phoſ" phoric acid,) acetous acid was poured on " the precipitate, by which it was immediate" ly diſſolved. The whole of the phoſphoric " acid was then ſeparated from this ſolution, " by acetite of lead; after which, leſt any " lead ſhould be preſent, the liquor was ſatu" rated with pure or cauſtic ammoniac, and " the lead was ſeparated by a filter: Laſtly, " the lime which remained diſſolved, was " precipitated (in the ſtate of carbonate) by " carbonate of ammoniac.

" The enamel has been ſuppoſed, not a " phoſphate but a carbonate of lime. This " error may have ariſen from its ſolubility in " acetous acid or diſtilled vinegar; but the

" effects of the acetous acid are, in every reſ-
" pect, the ſame on powdered bone as on the
" enamel. Conſequently, when enamel, or
" bone, is put into a glaſs matraſs containing
" acetous acid, placed in a ſand bath, the por-
" tion which is diſſolved, is not (as has been
" ſuppoſed) carbonate but phoſphate of lime;
" for, if to the filtrated ſolution nitrate or ace-
" tite of lead is added, a precipitate is produc-
" ed, of phoſphate of lead, in the ſame man-
" ner as when nitrate or acetite of lead is add-
" ed to urine."

Mr. Hatchett has made many other very intereſting experiments and obſervations on ſhell and bone, &c. the reſults of which would be too numerous to inſert, he however ſays that " the enamel appears only to be different
" from tooth or bone, by being deſtitute of
" cartilage, and by being principally formed
" of phoſphate of lime cemented by gluten.
" The difference, in the latter caſe, ſeems to
" explain why the bones and teeth of animals
" fed on madder become red, when, at the
" ſame time, the like colour is not commu-

"nicated to the enamel; for it appears pro-
"bable, that the cartilages which form the
"original ſtructure of the teeth and bones,
"become the channels by which the tinging
"principle is communicated and diffuſed *."
Mr. Hatchett at this period had not ſeen Dr. Rutherford's experiments and obſervations on madder.

From the foregoing obſervations, it is perfectly evident, that the moſt ſimple and beſt prepared tooth powder, frequently applied to the teeth, muſt be injurious, as they all tend to wear away the cortex ſtriatus. Even at preſent many people are not content with the uſe of tooth powder alone, but form it into a paſte with ſyrup or honey, by which its action is much increaſed; ſuch preparations certainly clean the teeth much ſooner than the others, they alſo much ſooner wear off the cortex ſtriatus and deſtroy its beautiful poliſh which never after can be regained.

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* Mr. Hatchett's experiments, &c. page 19. Philoſophical Tranſactions for 1799.

The tooth powders commonly ſold conſiſt in a great meaſure of cream of tartar, by the uſe of which I have ſeen the teeth completely deprived of their cortex ſtriatus and the patients rendered quite miſerable, for the bony part of the tooth in ſuch caſes becomes ſenſible to the ſlighteſt touch and alſo to the ſlighteſt change of temperature in the atmoſphere or other fluids received into the mouth. Cream of tartar alone has been recommended by Mr. Hunter as a tooth power, becauſe, as he ſays, "at the ſame time that it acts mechanically, "it has likewiſe a chemical power, and diſ"ſolves this adventitious matter *."

To aſcertain the bad effects of cream of tartar as a tooth powder, I made the following ſimple experiment, which will at once explain how very detrimental the uſe of it muſt be, even in the ſmalleſt proportion. I placed a tooth in a ſolution of cream of tartar and water, and allowed it to remain in it for about twelve hours, when taken out I obſerved that

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* Nat. Hiſt. part II. page 69.

the ſurface of the cortex ſtriatus was quite rough, and according as it became dry, it appeared ſprinkled over with an immenſe number of ſmall cryſtals though very few were obſervable on the root. The formation of theſe cryſtals can be eaſily accounted for : the acid of tartar has a greater affinity to calcareous earth than it has to the vegetable alkali with which it is combined in cream of tartar, a double elective attraction of courſe takes place when a tooth is immerſed in a ſolution of it, the acid of tartar combines with the lime and forms a ſalt nearly inſoluble in water and which is depoſited in the form of cryſtals on the body of the tooth, whilſt the other portions, ſcil. the vegetable alkali and phoſphoric acid, &c. combine and remain diſſolved in the mixture. Likewiſe in cream of tartar, the vegetable alkali is ſuperſaturated with the acid of tartar, ſo that even in powder and without a complete decompoſition of it, we ſee how readily it may act as a ſolvent for the cortex ſtriatus, which is ſeemingly the chief part acted on by it, the bony part as already mentioned being covered with ſcarcely any of the cryſtals.

ſtals. When a tooth is placed in dilute acid of tartar, the body of it becomes covered in the ſame ſpace of time with much larger cryſtals.

A variety of eſſences and lotions are alſo recommended and ſold for cleaning the teeth, many of which contain acids, and though perhaps but a very ſmall quantity, yet when conſtantly applied, they undoubtedly muſt diſſolve and deſtroy the cortex ſtriatus, &c. I ſhall terminate this chapter by ſeriouſly recommending parents to have their children's teeth and *gums* in particular bruſhed and waſhed with a ſoft bruſh and water at leaſt morning and evening, commencing at the period when the temporary teeth are complete, that is, in general about the ſecond year. This early attention will render the operation habitual, and I am fully convinced the benefits to be derived from it are almoſt incalculable.

If their teeth and gums are diſeaſed, I need not add that medical aſſiſtance ſhould be immediately procured, for I have met ſeveral caſes, in which (by neglecting to keep the gums of children in good order) ſome of the permanent teeth have been caſt off with the temporary ; one caſe in particular occurred to me of a child about three years old, in which the four permanent inciſores of the under jaw and a conſiderable portion of the jaw itſelf had been ſloughed off, by not attending to the child's mouth whilſt it was labouring under and after the recovery of the confluent ſmall pox ; this child of courſe will be disfigured through life.

CHAPTER XII.

Of Dentition.

THE human body, on account of the very great delicacy of its ſtructure, is at all periods of life ſubjected to a variety of complaints ; but by reaſon of the extraordinary degree of irritability during infancy, the body is then peculiarly ſuſceptible of morbid impreſſions, from even the ſlighteſt cauſe, eſpecially during the firſt year or two after birth. As ſome reaſon muſt be aſſigned for the various affections which then occur, and as moſt of the temporary teeth appear during this period, Empiricks (to ſcreen their ignorance) have hit on that theory moſt likely of all others to be received by the maſs of the people, viz. that theſe complaints were owing to the irritation, occaſioned by the violent efforts the teeth make in burſting and tearing through the gums. This opinion has been handed down from one generation to another, and we find the ancient as well as moſt of the modern phyſicians contenting themſelves with the old adage, that, " what every one ſays muſt be true" without thinking for themſelves, or accurately examining the appearances and ſtate of the parts, which alone could be acquired by diſſection.

It would be both tedious and unintereſting to the reader to collect and arrange the hypothetical remarks diffuſed through numberleſs volumes in order to ſupport this doctrine ; a few of their obſervations will therefore be ſufficient to ſhow how diſcordant they are one with the other, and alſo the very fallacious inductions they deduced from them. Hippocrates ſuppoſed the moſt violent affections aroſe from the cutting of the canine teeth *: Boerhaave on the other hand ſuppoſed they aroſe from the appearance of all the ſharp teeth, ſcil. the inciſores †; but his commentator Van Swieten differs with him and gives a moſt plauſible reaſon why ſome teeth work their paſſage through the gum with much leſs difficulty than others. He ſays, " As all the " foregoing diſorders proceed from the " ſtretching, puncturing, and lacerating the " nervous and bloody gums, it is evident " therefore that the worſt ſymptoms are to " be dreaded when the canine teeth are burſting out, becauſe they have an obtuſe point " and are pretty thick. The inciſores however reſemble a ſharp wedge; hence they " more eaſily cut through the incumbent " membrane than the former. But the mo- " lares, although they have a broader ſurface

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* Aphor. 25. Sect. 3. † Aphor. Sect. 1374.

" than the canini and alſo have four points, " are more eaſily borne by the child, becauſe " theſe points do not appear at one and the " ſame time but ſucceſſively *." Fauchard although he has adopted the ſame opinion as Van Swieten reſpecting the inciſores; nevertheleſs, comes nearer the truth when ſpeaking of the molares; he ſays, " The inciſores, being " ſmall and ſharp, cut through the gums with " leſs difficulty than the canini, and the child " ſuffers much leſs by them. The molares " however which are conſiderably larger and " nearly ſquare, pierce the gums with much " greater violence than any of the others, but

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[*] " Cum autem omnia hæc mala a tenſione, punc" turâ, laceratione, gingivarum nervoſarum, ſanguino" lentarumque, oriantur, patet facile, omnia hæc mala " magis metuenda eſſe, dum erumpunt dentes canini, " qui obtuſum apicem habent, et ſatis craſſi ſunt. In" ciſores acutum referunt cuneum; hinc facilius mem" branam incumbentem findunt. Molares autem, licet " latiorem ſuperficiem habeant quam canini, et qua" tuor apices, facilius feruntur; quoniam non ſimul " et ſemel, ſed ſucceſſive, illi apices emergunt." Com" ment. Vol. XIV. Pag. 746.

"as they appear very ſlowly and the child "gains ſtrength and age, it can ſupport with "leſs danger the pain produced by them*." Doctor Underwood differs from all theſe authors, for he ſays, "It will be frequently ne"ceſſary to lance the gums ſeveral times, on "account of the extraordinary difficulty with "which ſome infants cut their teeth, eſpeci"ally the double ones, which are furniſhed "with two or more knobs or points. Fever, "purging, and even convulſions, will ſome"times ariſe from only one point of a large "tooth offending the *perioſteum* that covers it; "and, being nearer the ſurface than the other "points, the lancet ſometimes does not com"pletely divide the membrane that lies over "the reſt; and this part not being injured

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[*] "Les dents inciſives étant plus petites et plus "tranchantes, percent plus aiſément que les canines, "et font beaucoup moins ſouffrir l'enfant. Les mo"laires, qui ſont bien plus groſſes et preſque carrées, "percent les gencives avec plus de violence; mais "comme elles ſont plus tardives, et que l'enfant a plus "d'âge et de force, il ſupporte plus aiſément la douleur." Le Chirurgien dentiſte, Vol. I. page 50.

" by the tooth, the ſymptoms ſubſide on " having divided that portion of membrane " that was inflamed. But, in a little time, " another point of the ſame tooth is found to " irritate the *perioſteum*, and calls for the like " aſſiſtance of the lancet, which again re- " moves all the complaints *." Thus we find all the temporary teeth accuſed (by one author or another) of producing (as they ſay) by their efforts to burſt out, almoſt every ſymptom and complaint that has been mentioned by Noſologiſts ; and each author in ſupport of his own doctrine attributing greater danger to the appearance of certain teeth than others, as well as the period of their appearance.

It cannot be doubted but that complaints which ariſe from very different ſources, have been and are at preſent attributed to teething. The celebrated Sydenham tells us " It is a " common obſervation that infants are fre- " quently thrown into fevers by the pains at-

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* Diſeaſes of Children, Vol. I. Pag. 217.

" tending dentition, which are not eaſily
" diſtinguiſhed from fevers of another kind.
" I have been long tormented with the treat-
" ment of thoſe, nor 'til lately, could I be per-
" ſuaded that any of them that were entruſt-
" ed to my care, were reſtored to health ſo
" much by art as accident, until having been
" frequently reminded of a remedy not very
" celebrated but rather diſregarded for being
" in common uſe, I however ordered it and
" found it anſwer my utmoſt expectation, be-
" ing preferable to any medicine I had previ-
" ouſly tried. It is two, three, or four drops
" of ſpirits of hartſhorn according to the age
" of the child, given in a ſpoon full of black
" cherry water or any other proper julap
" every fourth hour to the fourth or ſixth
" time*." I think it very probable Syden-

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* " Vulgo enim notiſſimum eſt infantes à doloribus
" ex dentitione ortis, ſæpiùs in febres agi, quæ haud ita
" facilè ab alterius generis febribus internoſcuntur.
" In harum ergo curatione diu multùmque angebar, nec
" niſi nuperis his annis certò mihi perſuadere potui
" quemlibet

ham fell into the very ſnare he wiſhed us to avoid, for it is not likely that a fever occaſioned by dentition, would yield ſo frequently, as he ſays, to a few drops of ſpirits of hartſhorn, at leaſt if ſuch violent irritation is produced in the ſyſtem as is ſo generally ſuppoſed: It appears however that this medicine has been in conſiderable uſe and repute, for Boerhaave tells us, that convulſions ariſing from dentition have been happily cured by a ſmall doſe of the volatile alkali *. Such convulſions I ſhould think aroſe from ſome derangement

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“ quemlibet ex illis qui meæ curæ concrediti ad ſanitatem reſtituti fuerunt, tam arte quâm caſu convaluiſſe, “ donec tandem de felici ſucceſſu remedii haud ita celebris, imo ad tritum ejus uſum planè contempti, “ frequenter admonitus, illud ipſe quoque præſcriberem; quod etiamnum præ cæteris quæ mihi innoteſcunt medicamentis optimè votis hic reſpondet. “ Ejuſmodi verum eſt guttæ duæ, tres, vel quatuor “ *ſpiritus* cor. cerv. pro ratione ætatis, in cochleari “ uno vel altero aq. ceraſor. nigr. vel julapii alterius “ appropriati exhibeantur quarta quaque horâ ad vices “ quatuor vel ſex.” Opera Univerſa, pag. 504.

[*] Aphor. 1378.

either of the ſtomach or bowels and not from teething.

It is not my intention to point out the medical treatment of children during theſe periods, but conciſely to mention in what manner (as far as I can judge) the appearance of the teeth might occaſion violent and dangerous ſymptoms, and alſo how they may be avoided. It is likewiſe neceſſary to inveſtigate the preſent mode of lancing the gums, an operation which has been in general uſe and recommended by the firſt authorities.

I deſignedly omitted, when treating of the commencement and formation of the permanent teeth, ſaying any thing particular reſpecting the change which then takes place in the ſockets of the temporary; but reſerved it for this place. Soon after the permanent ſacs have commenced and that each ſac becomes ſurrounded with a bony ſocket, there is a diſpoſition in the plates of the alveolar proceſſes to contract a little over the ſurfaces of the temporary teeth, and as Mr. Hunter juſtly remarks,

marks, “ The alveolar proceſſes grow, and “ for ſome time keep the ſtart of the teeth, and “ perhaps the reaſon why the mouths of the “ ſockets have this tendency to contract, is in “ order to ſupport the gums, and prevent “ them being injured before the teeth come “ through *.” The ſtructure of the gum I likewiſe reſerved : It ſeems a ſubſtance *ſui generis*, externally it is covered by the cuticle which lines the mouth and which can be readily ſeparated from it, immediately under the cuticle it appears compoſed of cellular membrane and a plexus or net work of veſſels. The external *perioſteum* of the jaw ſeems loſt in it, and I could not afterwards by any means ſeparate it into lamellæ. The gum ſeems a ſubſtance (as I have had frequent occaſion to mention) deſigned in a certain degree to form and afterwards to accompany and ſupport the teeth through life, and in old age to become a callous covering to the jaws, deprived of teeth and alveolar proceſſes. The gums in general are not poſſeſſed of much ſenſibility, but when irritated even by ſlight cauſes, they are apt to inflame and become remarkably tender and painful, ſimilar to the *tendinous aponeuroſis* &c.

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* Nat. Hiſt. page 75.

In all the examples we have been examining, I have ſhown that in proportion as the teeth riſe, the upper parts of the ſockets expoſed to their preſſure are abſorbed; and I have repeatedly ſhown that as ſoon as the inveſting membrane had perfected the cortex ſtriatus, it was waſted, the gum we have ſeen partakes of this tendency to waſte or is abſorbed and the teeth commonly paſs with great eaſe through it and frequently without the knowledge of the mother or nurſe. In ſome few caſes however where nature does not preſerve her regular mode of action, violent ſymptoms may ariſe: for inſtance if the root or roots advance more rapidly than the body of the tooth, the veſſels of the gum and even thoſe of the inveſting membrane may become inflamed. Such caſes however I look on to be very rare, and I do not think, that this natural proceſs in the animal œconomy, in which all animals (man excepted)

cepted) ſeem to ſuffer little or no inconvenience, ſhould be accounted and ranked as a moſt fatal diſeaſe. Doctor Caddogan in his eſſay on nurſing introduces the following valuable remarks, " Breeding teeth has been thought " to be and is fatal to many children; but I " am confident this is not from nature; for it " is no diſeaſe, or we could not be well in " health till one or two and twenty, or later. " Teeth are breeding the greateſt part of that " time; and, it is my opinion, the laſt teeth " give more pain than the firſt, as the bones " and gums they are to pierce are grown more " firm and hard."

We ſhall now examine into the means of relief, which have been employed, and thoſe alſo which may occaſion the teeth to cut eaſily. Boerhaave ſays *, " This may be " effected, 1ſt. by ſoftening, cooling, and " aſſuaging the gums, with ſoft, glutinous

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* " Quod fit. 1. gingivas emolliendo, refrigerando, " leniendo, mollibus, glutinoſis, antiphlogiſticis; 2. " ſæpe atterendo ad corpora dura, glabra; 3. diſſecando ope lanceolæ." Aphor. 1377.

" and antiphlogiſtic remedies. 2dly, By often " rubbing them with hard, ſmooth bodies. " 3dly, By cutting them with a lancet." The practice of rubbing the gums of children with coral and other hard but ſmooth bodies, in order to make the teeth cut eaſily, is ſtill recommended by all writers on the diſeaſes of children. Doctor Underwood obſerves, " ſe-" vere ſymptoms could not ariſe merely from " the teeth piercing the gum, which it has " been ſaid is not a very ſenſible part *." He therefore recommends the uſe of coral, &c. but chiefly depends on the operation preſently to be mentioned: coral or any other ſmooth hard body which is uſually given children to bite, with a view to aſſiſt the cutting of the teeth, I look upon to be a moſt dangerous weapon put into their hands to deſtroy themſelves; for as the teeth riſe and become ſlightly elevated above the edge of the ſocket, thoſe hard bodies preſs and bruiſe the gum between them and the ſharp points or edge of the tooth underneath: inflammation and its conſequences undoubtedly follow, and in this way

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* Diſeaſes of Children, page 214.

I am firmly perſuaded the lives of thouſands of children have been loſt. Doctor Munro warns us againſt the uſe of ſuch ſubſtances, and recommends the child to be allowed to make uſe of its own fingers, he does away the old prejudice, that if children were allowed to ſuck their fingers the ſize of them would be diminiſhed. I would add to this, that the nurſe may now and then rub the gums of the child gently with her finger, where a tooth is about to appear; children ſeem to receive great pleaſure from it. Every ſpecies of gum-ſtick ſhould be undoubtedly laid aſide, a child ſhould not be allowed even a cruſt of bread, unleſs the hard outſide part was ſcraped off and afterwards moiſtened in milk or water.

From theſe obſervations it is ſufficiently obvious that violent ſymptoms may ariſe from the irritation occaſioned by the appearance of any one of the temporary teeth or even the permanent. Doctor Rutherford ſaw a caſe of chorea produced in a child about eight or nine years of age, by the permanent inciſores cutting at the internal part of the mouth and Dr. Munro relates a caſe of its being produced in a youth by the appearance of the wiſdom teeth.

With reſpect to lancing the gums of children, Dr. Underwood ſays *, " When it is found " neceſſary to lance the gums, (which is ever, " at leaſt, a ſafe operation) it ſhould always " be done effectually with a proper gum lancet, which will ſufficiently divide the gum " or ſtrong membrane that covers the teeth. " The lancet ſhould always be carried quite " down to them, and in certain caſes it will " often be proper to draw the lancet along a " great part of one or even both the jaws, at " the ſame operation. Some writers, however, and Doctor Millar particularly, have " adviſed not to cut quite down to the teeth, " but only to ſcarify the gums, unleſs the " teeth are very near, for fear of injuring the " ſucceeding teeth. But this is a needleſs " ſcruple, and I apprehend ariſes for want of " duly attending to the ſtate of the teeth.

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* Diſeaſes of Children, Vol. I. Pag. 213, 218, 220.

" For the firſt teeth of infants conſtantly become carious at the roots, and are looſened " and expelled by that means, when left to " nature alone ; and though the upper parts " of the new teeth are in contact with the carious bottoms of the firſt ſet, they never " ſuffer from this circumſtance. I have, " however, written from *experience*, and am " *perfectly ſatisfied* of the propriety and ſafety " of what I have ventured to recommend." Doctor Underwood however does not ſeem to have paid much attention to the ſtate of the teeth in children, nor indeed to the animal œconomy ; if he had, he would not have aſſerted that the roots of the temporary teeth become carious in order that they might be expelled. Lancing the gums likewiſe is not altogether ſo ſimple or ſafe an operation as Doctor Underwood ſeems to think, for from what I have demonſtrated in Chapter IV. reſpecting the connexion which ſubſiſts between the temporary and permanent teeth, the connecting membranes and ſacs of the permanent teeth muſt have been conſtantly cut by the common mode of operating ; the formation of the permanent teeth muſt of courſe be much impeded, ed, and probably ſometimes entirely deſtroyed, by the frequent repetition of the operation. Lancing the gums of ſickly children has ſometimes terminated in gangrene and death; my late friend Surgeon Deaſe told me he met ſeveral inſtances of this kind. On the whole, the operation has been often performed unneceſſarily and without benefit; complaints, as I ſaid before, ariſing from totally different ſources have been attributed to teething, and recourſe immediately had to the lancet. Doctor Hudſon ſays, "Concerning your queſtion about lancing the gums of children, I have avoided making it a ſource of revenue to myſelf, convinced from experience of its futility, except in inflammatory caſes, and where the teeth were near the ſurface; in ſuch caſes the lancet gave relief, and I believe ſeldom or never on other occaſions. Where I have operated by advice of the attending phyſician, it is true, many children have recovered after the operation, but I could never fairly ſay the recovery was in conſequence thereof."

When we are convinced of the neceſſity of performing the operation, the inciſion ſhould be made towards the external plate of the alveolar proceſſes, ſo as to avoid the connecting membranes and ſacs of the permanent teeth, particularly thoſe of the inciſores and cuſpidati, thoſe of the bicuſpides are more eaſily avoided on account of the flat and broad ſurfaces of the temporary Grinders: or two oblique inciſions might be made with a ſimilar view, beginning at the internal part and meeting in an angle about the middle of the tooth or external plate of the alveolar proceſs, ſo that the connecting membranes and permanent ſockets might be contained within the ſpace formed by both inciſions, the method of doing which can be eaſily conceived by obſerving the relative ſituation of the temporary and permanent ſockets as repreſented in Tab. iii. Fig. 2. Alſo where adviſable a ſmall horizontal portion of the gum might be cut out particularly over the inciſores, &c. For theſe operations the inſtrument I in general make uſe of is repreſented in Tab. vii. Fig. 1.

The advantages gained by the operation I conceive are in a great meaſure owing to the tenſion of the veſſels, &c. being removed by the ſmall quantity of blood drawn from the inflamed part of the gum. I have been particular in pointing out the order and period in which the temporary teeth appear, that we might not err in lancing the gum over the proper tooth, that is, the one which is about to appear *. We ſhould by no means cut or hack the gums in the manner Doctor Underwood recommends, nor do I ſee any neceſſity of penetrating ſo deep, or drawing the lancet over a great part of one or both jaws at the ſame operation as he alſo ſays is ſometimes neceſſary. Doctor Underwood was certainly not aware of the miſchief that might be done to the ſockets and neighbouring imperfectly formed permanent teeth when he recommends ſuch an extenſive inciſion. Neither can I ſee the neceſſity there is of performing the operation nine or ten times over one tooth as Doctor Underwood and Mr. Hunter have done, for,

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* Vide Chapter III.

if the gum is frequently lanced previous to the tooth riſing above the edge of the ſocket, its formation is impeded, the root or roots of courſe do not increaſe rapidly and they for the moſt part appear later than they otherwiſe would do.

By a frequent repetition of the operation I have ſometimes ſeen the temporary inciſores appear through the gum imperfectly formed, and ſoon after their appearance they became looſe and fell out, no roots being formed to retain them in the ſockets. I ſhall conclude by ſaying, that I do not think lancing the gums of children is altogether ſo ſafe an operation as has been heretofore imagined, and that great caution ſhould be uſed in the method of performing it, and alſo we ſhould be perfectly certain of its neceſſity. For as I often ſaid before, complaints ariſing from totally different ſources have been attributed to teething, and the children tortured without receiving the ſlighteſt benefit or relief by the operation.

It is neceſſary to add that the appearance of the wiſdom teeth ſometimes occaſions a vaſt deal of uneaſineſs and pain, particularly when they are formed immediately under the zygomatic proceſs of the lower jaw or tubercle of the upper; this happens where the jaws do not extend ſufficiently ſo as to allow a regular diſpoſition of the teeth, the gum being ſqueezed and bruiſed by the frequent motion of the jaw in chewing, becomes inflamed, amazingly tender and painful. Lancing or cutting out part of the gum over the tooth ſometimes gives relief. But Mr. Hunter and other modern ſurgical writers being expert at operating, recommend (in thoſe caſes where lancing the gum does not give relief) to have the wiſdom tooth taken out, expert indeed they muſt be who could take out a tooth in ſuch a ſituation, nor could it be effected without tearing away a conſiderable portion of the coronoid proceſs or jaw. What I have found anſwer every intention in ſuch caſes, is to take out the middle Grinder, the wiſdom tooth ſoon after moves forward into the place of the former; and the violent ſymptoms of courſe ceaſe.

SUPPLEMENT.

SOME time previous to the publication of my inaugural diſſertation in September, 1798, whilſt aſſiſting Doctor Munro, jun. to arrange ſome of his father's valuable preparations of the teeth, I obſerved amongſt them an elephant's grinder, and at once diſcovered its beautiful ſtructure and likewiſe the manner of its formation. In order to aſcertain theſe facts I got permiſſion from the Doctor after my own plan to have a longitudinal ſection made of it and afterwards poliſhed, one half of which he kindly preſented me with. I immediately ſhowed and explained its ſtructure, &c. to my learned friend Doctor Rutherford and alſo to Doctor Munro, ſen. as well as many other gentlemen. A drawing was copied from it by Mr. Alſton, which I entruſted to an ingenious artiſt Mr. Scott to engrave for me, the

plate

plate of which I intended to have annexed to my theſis, but found it could not be finiſhed in time for the graduation, of courſe I reſerved it for the preſent work.

At this period John Corſe, Eſq. came down from London to Edinburgh, and as he had made many intereſting and valuable obſervations in the Eaſt Indies on the œconomy and natural hiſtory of the elephant, and alſo on their mode of dentition, Doctor Munro ſen. mentioned to him the diſcoveries I had made on the ſtructure and formation of the teeth in general and particularly on the grinders of the elephant, and ſhortly afterwards was kind enough to introduce me to him. Mr. Corſe told me he was not at all acquainted with the ſtructure of the elephants teeth nor indeed with the ſtructure of the teeth of any graminivorous animal, that his object alone was to point out what he ſaid he had diſcovered, ſcil. “ The mode of dentition of the elephant, “ or the progreſſive motion of one grinder “ into the place of another in proportion as “ the anterior one is worn away.” According-ing to appointment we met at my apartments in order that I might demonſtrate my preparations of the teeth in general to Mr. Corſe: which I did, and alſo explained to him how a ſection ſhould be made of an elephants grinder to ſhow its internal ſtructure, a ſection ſimilar Mr. Corſe confeſſed he never before ſaw. Doctor Munro, jun. and my friend Doctor William Armſtrong were preſent at this demonſtration. Mr. Corſe told me he would undoubtedly do me juſtice, and that he would mention my diſcoveries of the ſtructure and formation of the elephants grinders in his intended publication on the different ſpecies of Aſiatic elephants and their mode of dentition.

Mr. Corſe requeſted me to meet him in London, and that he would give me permiſſion to prepare, in any manner I pleaſed, ſeveral valuable preparations of the heads of elephants he had collected and brought from the Eaſt, and to publiſh drawings from them according to my own plan; unfortunately I could not at that time take advantage of his kind offer.

Mr. Thomas Blizard of the London Hoſpital was in Edinburgh nearly at the ſame time, to whom alſo I demonſtrated my preparations.

The engraving of the elephants grinder being finiſhed in October 1798, I gave impreſſions of it to Doctors Munro, Rutherford, Armſtrong, &c. and to Mr. John Bell, Mr. Alexander Ramſey, and many other gentlemen. Mr. Corſe had left Edinburgh previous to this period.

Having returned to Dublin in November 1798, I determined as ſoon as poſſible to viſit London and avail myſelf of Mr. Corſe's generous offer, but could not arrange my affairs ſo as to go there until September 1799. On my arrival in London I immediately waited on Mr. Corſe, and found to my very great aſtoniſhment as well as diſappointment, that he had already publiſhed a ſection ſimilar to mine of an elephants grinder, without once mentioning my name as having originally diſcovered its ſtructure and formation, and alſo ſome other of my obſervations which ſhall afterwards be noticed *. Mr. Corſe endeavoured to apologiſe to me for this conduct, by ſaying, that he had explained my obſervations to Mr. Everard Home of London, and alſo that he had put my theſis (a copy of which I preſented Mr. Corſe) into his hands, Mr. Corſe therefore *ſuppoſed* Mr. Home would have mentioned my diſcoveries in his intended work which was to have been added as a ſupplement to Mr. Corſe's. However on looking over Mr. Home's work †, I was not a little ſurpriſed to find that he (Mr. Home) had publiſhed moſt of my diſcoveries as his own, reſpecting the teeth of graminivorous animals, and artfully contrived to alter ſome of ~~the~~ the terms I made uſe of; for inſtance, what I have uniformly called bone Mr. Home calls ivory, and what I have called the cruſta petroſa Mr. Home calls bone. He has of courſe avoided mentioning my name or refering to my theſis.

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* Mr. Corſe's obſervations on the different ſpecies of Aſiatic Elephants. Tab. XII. Philoſophical Tranſactions for 1799.

† Mr. Home's obſervations on the Structure of the Teeth of graminivorous quadrupeds. Philoſophical Tranſactions for 1799.

Having brought to London with me a few impreſſions of the plate repreſenting my ſection of the elephants grinder, I preſented them, and at the ſame time explained this illiberal tranſaction and my priority of claim to the diſcovery of the ſtructure and formation of the teeth of graminivorous animals in general to ſeveral of the firſt medical characters I had the honor of being introduced to, and alſo to that liberal patron of ſcience the preſident of the Royal Society, Sir Joſeph Banks. This in ſome meaſure reconciles me to the unforeſeen delay of its appearing previous to this period. I have alſo to add the pleaſing reflection of my priority of claim being eſtabliſhed and ſupported by the Univerſity of Edinburgh.

It now remains for me to expatiate a little on both theſe works, (ſcil. Mr. Corſe's and Mr. Home's) and to explain the ſtructure and formation of the elephants grinders, which (notwithſtanding the advantages Mr. Corſe and Mr. Home have had in the poſſeſſion of my theſis and obſervations) neither of them as yet perfectly underſtand; and although I have had an opportunity of ſeeing all Mr. Corſe's and Mr. Hunter's valuable preparations I do not find it neceſſary to deviate in the ſlighteſt degree from the manner in which I originally explained their ſtructure and formation to Mr. Corſe.

As many very valuable and intereſting obſervations have been made by ſeveral authors on the different ſpecies of elephants, their mode of dentition, as well as the ſtructure and formation of their grinders, moſt of which were publiſhed in the Philoſophical Tranſactions about the beginning of the laſt century, I ſhall occaſionally refer to them.

I mentioned to Mr. Corſe in Edinburgh, that the pulp of an elephants grinder was divided into a number of conical proceſſes, and that duplicatures of the inveſting membrane paſſed down between theſe proceſſes to form the cortex ſtriatus—that oſſification commenced on the higheſt point or points of theſe proceſſes, and formed conical bony ſhells on them, which extended downwards for many inches previous tothe junction of their ſides—that as ſoon as the bony ſhells were perceptible the internal lamella of the inveſting membrane began to depoſit the ſoft earthy matter of the cortex ſtriatus on their external and upper ſurface, and that as ſoon as it was cryſtallized on the upper part of the ſhells, the inveſting membrane aſſumed a different mode of action and began to depoſit a cruſta petroſa on their points and ſides, in order to fill up the interſtices or ſpaces between the ſhells where the membrane paſſed down to form the cortex ſtriatus, in a ſimilar manner to thoſe of the horſe—that previous to the appearance of the tooth through the gum, one continued line of the cortex ſtriatus could be traced as far as the oſſification and junction of the ſides of the ſhells were complete, but that in proportion as the tooth came into uſe and was worn down by grinding, the connexion of the cortex ſtriatus, as well as that of the cruſta petroſa, were cut off, that then the cruſta petroſa and bony part appeared alternately between the ridges or plates of the cortex ſtriatus on its grinding ſurface—that as oſſification advanced the pulp extended and ſent off proceſſes to form roots, that the tooth roſe and continued to riſe by the formation and addition of new bony matter to the roots, in proportion to the detrition of the grinding ſurface, until the entire tooth was worn away—that the cruſta petroſa was depoſited on the external ſurface of the tooth as long as any portion of it remained within the jaw—that the junction of the ſides of the ſhells and plates of the cortex ſtriatus was in every reſpect ſimilar to what I had obſerved in the teeth of other graminivorous animals.

I then ſhowed and explained to Mr. Corſe my ſection and drawing of the elephants grinder as repreſented in Tab. VIII. the tooth being perfectly formed and a conſiderable portion of it worn away by grinding. The cruſta petroſa is repreſented externally, which the figures 1, 2, 3, 4, &c. denote. One continued winding line of the cortex ſtriatus can be traced commencing at *e*, until it is cut off by grinding as at *c*. The bony part on which the fibres of the cortex ſtriatus are arranged appears wavy as at *a*, and the junction of the bony ſhells and cortex ſtriatus is ſhown at *d. d. d.* The plates of the cortex ſtriatus at 12, had been originally nearly as long as thoſe at the oppoſite ſide, and the veſſels entered the hole at *b.* to nouriſh the remains of the pulp contained in the cavity of the tooth; the roots are ſufficiently diſtinct. I ſhall now requeſt the candid reader to compare this plate with that of Tab. 12. of Mr. Corſe's work, and alſo with Tab. xiii. xv. and xvii. of Mr. Homes. Alſo to compare Fig. 5. Plate 5. of my theſis, with that of Mr. Corſe's, Tab. viii. Fig. 1. and 2. from which figure the idea of both theſe were taken, to ſhow the junction of the bony ſhells, and how the pulp becomes ſeparated from the inveſting membrane.

I mentioned in my theſis, (page 81), that the cruſta petroſa was much harder and more brittle than the proper bony part of a tooth, but leſs hard and brittle than the cortex ſtriatus, and that of courſe it did not wear down ſo faſt as the bony part. In this probably I have been too nice, for in one caſe the cruſta petroſa wears faſter than the bone, in another the bone wears faſter than it, and although in the cow, ſheep, &c. it is more brittle than the bony part, in other animals it may not be, nor is it ſo hard on the tuſks of the ſpermaceti whale, ſea cow, nor even on the grinders of the elephant.

In one of the interviews I had with Mr. Corſe in London, and at which Doctor William Armſtrong was preſent, he ſaid the reaſon why he did not mention the ſubſtance I called the cruſta petroſa in his work was, that in about a month after he had ſeen me in Edinburgh, he had ſeveral converſations with Mr. Home in London on this ſubject, and that on ſhowing Mr. Home my theſis and his valuable preparations (the phyſiology of which Mr. Home at that time was not well acquainted with) Mr. Home ſaid the ſubſtance I called the cruſta petroſa was not materially different from common bone, and that it would be found ſofter than the centers of the ſtrata compoſing the grinder ; and becauſe, on poliſhing a ſection of one of the elephants grinders, this ſubſtance was found ſofter than the bone, Mr. Corſe ſaid he gave up the idea of a third ſubſtance entering their compoſition. This is a flimſy excuſe indeed, for as I mentioned in my theſis the cruſta petroſa differs in colour as well as texture and formation from the other two component parts of the tooth, ſcil. the cortex ſtriatus and bone. Mr. Corſe however in his work has altered the appellations I made uſe of and ſlyly marks the three different component parts of the tooth ; for inſtance, in explanation of Plate xii. he calls the cruſta petroſa the *bony cruſt*, and the proper bony part of the tooth he calls the *bony matter*. Explanation of Plate xii. *F. F. F. G. G. H. H. H.*

After this ſimple ſtatement of facts Mr. Home has the modeſty to aſſert, " From theſe " two ſources (viz. Mr. Corſe's obſervations " and preparations, and alſo preparations of " the elephants teeth preſerved in ſpirit in

"Mr. Hunter's collection) I was enabled to "procure every information that was required, to explain the ſtructure of the elephants "teeth and to point out the general principle "upon which all teeth are formed that have "the enamel intermixed with the ſubſtance "of the tooth; *a ſubject, as far as I am acquainted, not hitherto inveſtigated.*" Mr. Home adds, "I was deſirous that the facts "which I *had diſcovered* reſpecting the "*ſtructure* of the elephant's teeth, ſhould be "introduced into his paper, to render the "account more complete: this offer, Mr. "Corſe however declined, not chooſing to "bring forward any thing that was not wholly his own*." Did Mr. Home ſuppoſe that my diſcoveries and obſervations on the teeth of man and various animals (becauſe they were publiſhed in a *theſis*) would be thrown aſide and not noticed? Did Mr. Corſe and Mr. Home ſuppoſe I would not, or could not vindicate my own priority of claim and make this tranſaction public ? I do it in ſupport of ſcience, more than for my own celebrity ; I do it to put a ſtop if poſſible to ſuch plagiariſms, and give a zeſt to thoſe who are engaged in the ſtudies of Nature.

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* Mr. Home's obſervations, &c. Philoſophical Tranſactions for 1799, page 1 and 2.

To enter into a full refutation of many of the principles laid down by Mr. Corſe and Mr. Home would be foreign to my preſent purpoſe, I cannot however paſs over ſome of their remarks and erroneous ideas. Mr. Corſe ſays, (page 9) " A grinder is compoſed of ſe-" veral diſtinct laminæ or teeth, each covered " by its proper enamel ; and that theſe teeth " are merely joined to each other by an inter-" mediate ſubſtance acting like a cement." This was the opinion of the celebrated Ray *. It was alſo the opinion of Doctor Patrick Blair, who has diſplayed great anatomical knowledge, perſeverance and accuracy, in his diſſection of an elephant that died at Dundee in Scotland,

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* " Plurimi dentes in os ſolidum et durum ita infixi " ſunt, ut cum eo et inter ſe unum et continuum cor-" pus efficiant." Synopſis Animal. Quadruped.

An. 1706. He very nearly diſcovered the ſtructure and formation of their teeth, but calls the bony ſhells the rudiments of the teeth *. "Several of which rudiments he obſerved "lying ſtratum ſuper ſtratum or placed per-"pendicularly acroſs the jaw, they were two "or three times interſected by membranes "whereby they could be disjoined, but after "he had taken out ſeveral of theſe rudiments, "he obſerved no more ſuch ſeparation. "Where the ligaments ceaſe they become ex-"tremely ſolid and ponderous, and at their "upper extremity half round and ſometimes "formed into digitations, from which there "run ſeveral ridges and ſulci †. 'Tis obſerva-"ble, that at their upper extremity there is a "*lamina*, which being convex toward the "jaw, and concave toward theſe rudiments of "teeth, does as it were knit their ſolid extre-

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[*] Philoſophical Tranſactions abridged by Henry Jones, Vol. V. Part I. Page 120.

[†] Tab. ix. Fig. 2. *a b.* of my Eſſay, this drawing of one of the rudiments or rather ſhells was copied accurately from Plate vi. Fig. 90. of Doctor Blair's, it is not however near the natural ſize.

" mities together, before they appear without " the jaw." It was likewiſe the opinion of Doctor T. Molyneux[*], Tentzelius[†], and others.

If an elephant's grinder was compoſed of ſeveral diſtinct teeth and if each of them were covered by its proper enamel, there ſhould have been different pulps and membranes to form each tooth: but it is not ſo, there is (as I told Mr. Corſe) but one pulp which is divided into a number of conical proceſſes, and in proportion as the anterior proceſſes are oſſified, the pulp ſends backwards a certain number of additional proceſſes, to enlarge the tooth, ſuch as are noticed in my theſis, page 78. If likewiſe a grinder (or caſe of teeth) as Mr. Corſe calls it, was formed of a number of teeth merely cemented together by an intermediate ſubſtance, there could not be that beautiful winding and continued line of the cortex ſtriatus over the bony part which I diſcovered, and which is repreſented in Plate ix. Fig. 1. as far as the junction of the ſides of the ſhells is complete, and which connected line as well as the arrangement of the fibres of the cortex ſtriatus Mr. Corſe and Mr. Home have repreſented after my plan, although the fibres of the cortex ſtriatus, owing to the peculiar arrangement of them, are not ſo diſtinct in a ſection or fracture of an elephant's tooth, as in thoſe of the cow, &c.

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[*] Philoſophical Tranſactions abridged, Vol. IV. Part II. Page 238.

[†] Ibid. Vol. II. Page 440.

I have ſhown that Dr. Blair in a certain degree noticed the ſubſtance I have called the cruſta petroſa in the elephants grinders, but in addition to his ingenious remarks I will add thoſe of the Rev. Mr. Morton, which are introduced in Sir Hans Sloane's Eſſay on the teeth and bones of elephants *. Mr. Morton ſays, " The grinder whole, or however all " the pieces of it I could find (for it was broken " into three or four in taking it up) being put " together as they grew, exhibit thirteen or

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* Philoſophical Tranſactions abridged, Vol. VI. Part III. Page 30.

" fourteen parallel lamellæ ; each of which
" extends the whole length and almoſt the
" whole thickneſs of the tooth ; and of theſe
" for the main it is compoſed. But in a live
" or perfect tooth theſe lamellæ do not appear
" ſo plainly, being in part cruſted over with a
" white oſſeous cruſt or integument, which in
" this foſſil tooth is almoſt wholly periſhed
" and gone, inſomuch that the lamellæ are
" more expoſed to view. From the root to
" the top in the longeſt part, which is near the
" middle of it, it is juſt ſeven inches long.
" None of the lamellæ are contiguous ; there
" interpoſes betwixt them a thinner plate of a
" white colour and a laxer texture. Three
" or four of the outmoſt at one end of the pile
" appear undulated at the top of the tooth, are
" near as broad at top as at the root, and
" have a blunt ending. The reſt of them are
" by degrees contracted to a point, are gradu-
" ally ſhorter and ſhorter to the other extre-
" mity of the pile, and alſo bend a little over
" one another. And each of them, as it ap-
" proaches the top divides, as it were, into
" ſeveral ſmaller teeth." This deſcription of
Mr.

Mr. Morton's is very accurate and conciſe; if he had made a ſection ſimilar to mine, he would have noticed the three component parts of which an elephant's tooth conſiſts; the ſubſtance I have called cruſta petroſa he calls the *oſſeous cruſt*, but did not underſtand the manner of its formation; in this reſpect Dr. Blair was better acquainted with the ſubject.

I have mentioned in my theſis, page 81, that the inveſting membrane, after it had depoſited and perfected the cortex ſtriatus on the teeth of graminivorous and ruminant animals, aſſumed a different mode of action, and depoſited the cruſta petroſa—that the upper grinders in general of the horſe remained ſufficiently long under the gum to allow the internal cavities to be filled with the cruſta petroſa, otherwiſe they would be filled with broken particles of the teeth and food, as they are in the cow, ſheep, deer, &c. the nouriſhment being cut off from the internal duplicatures of the membrane by the appearance of the tooth. But as an elephant's grinder is differently conſtructed, the proceſſes of its pulp and ſhells being placed almoſt perpendicularly acroſs the jaw, and the interſtices between them extend from one ſide of the ſocket to the other, the internal duplicatures of the inveſting membrane continue to be nouriſhed from the ſides, even after the upper part of the tooth has been perfected, and that part of its membrane waſted by the appearance of the tooth through the gum. This beautiful contrivance was neceſſary, otherwiſe as the proceſſes of the pulp elongate and the bony ſhells extend downwards on them many inches previous to the junction of their edges, the upper part of the cavity or interſtice between them would be filled by the cruſta petroſa, whilſt the lower part of it would be empty, which ſometimes, tho' ſeldom, happens in the upper grinders of the horſe. The tooth would not be ſo ſtrong or laſting as it is, nor would the earthy matter of the cortex ſtriatus be perfectly cryſtallized down to the junction of the ſhells, but remain in a ſoft ſtate.

As the lower and alternate edges of the ſhells muſt be joined, previous to the depoſition

tion and cryſtallization of the cortex ſtriatus on that part of the tooth, a ſpace is ſeen in Tab. ix. Fig. 1. a little above *d.* which was not at this period filled by the cruſta petroſa. In this growing tooth (with which Mr. Corſe was liberal enough to preſent me) ſeveral of the poſterior ſhells were as yet quite ſeparate, ſections of two only of them are repreſented, which will give an adequate idea of the others, excepting that they are progreſſively ſmaller; the number of theſe ſhells varies according to the kind of tooth or age of the animal, being from four to twenty-three*. In foſſil teeth I have however counted thirty-four of them. In proportion as oſſification advances and the cortex ſtriatus is perfected, the cruſta petroſa is depoſited, fills up the interſtices between the ſhells, and unites them in a certain degree at the upper part a long time previous to the junction of the edges of the ſhells at bottom, this muſt neceſſarily happen on account of the gradual progreſs of the formation of the tooth, and which can be eaſily underſtood by viewing Plate ix. Fig. 1. If the ſhells, as Mr. Corſe ſays, were different teeth and merely cemented together by the cruſta petroſa, it would paſs down quite through the entire ſubſtance of the tooth ; but it does not, it terminates at the junction of the bony ſhells and plates of the cortex ſtriatus. The cruſta petroſa ſerves a purpoſe ſimilar to that noticed in Chapter VIII. with reſpect to the teeth of the horſe, &c. it extends conſiderably beyond the ſhells and renders the interſtices between them ſmooth, as Mr. Morton well obſerves. In proportion as the alternate edges of the ſhells unite, they complete the body of the tooth from which the roots commence : the tooth repreſented in Tab. ix. was not ſufficiently advanced to have roots formed, but in Tab. viii. they are repreſented perfectly formed, which gives a ſufficiently accurate idea of them.

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* See Mr. Corſe's Obſervations, page 11.

In proportion as the rudiment of the firſt grinder is tolerably advanced, its membrane ſends backwards a proceſs to form a ſecond, (and from the ſecond to the third, and ſo on,) both of which are at firſt contained in the ſame ſocket, but as oſſification advances they become ſeparate : a hole of communication however is preſerved, through which the connecting membrane paſſes. This connexion Mr. Corſe ſpeaks of (page 14,) and borrowed the idea from my obſervations, but did not mention it as my diſcovery, becauſe Mr. Home told him " he did not think it worthy of notice."

Dr. Moulins, Dr. Blair, Dr. T. Molyneux and many others were very much at a loſs to determine the number of grinders an elephant in general ought to have, on account of the irregular ſituation of the teeth in different elephants, and alſo the uſe of thoſe they obſerved in an incipient ſtate ; Dr. Moulins ſays in his anatomical account of the elephant accidentally burned in Dublin in the year 1681, (London 1682) page 40. " There were be-
" ſides the tuſks only four teeth in each jaw,
" two in every ſide, he had no inciſores.
" The length of each of the inner teeth of
" the lower jaw was about ſix inches and a

" half, but the outward of the ſame jaw was " only one inch and three quarters long. " The length of the hinder tooth in the right " upper jaw was four inches, but that of the " oppoſite was but three, the two outward " teeth of the upper jaw were ſomewhat long" er than thoſe of the under, the greateſt " breadth of the teeth was two inches and three " quarters, the height of the teeth above the " jaw was about one inch and three quarters." Dr. T. Molyneux ingeniouſly obſerves *, " It " appears that the number of molares in the " elephant is not certain; and although by " the obſervations of Mr. Du Verney, Dr. " Moulins, and Dr. Blair, who diſſected three " different elephants, it appears that each of " them had eight molares, yet in the diviſion " of them nature obſerves no rule; for Dr. " Moulins found that in the upper jaw the " inner tooth on one ſide was bigger than its " fellow, and Mr. Du Verney and Dr. Blair " had on both ſides the much greater tooth

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* Philoſophical Tranſactions abridged, Vol. IV. Part II. page 244.

" outwards: whereas the Weſtminſter ſkull,
" on the contrary, has only a ſmall one out-
" wards, and the much greater grinder within.
" In this ſkull there were only ſix teeth, viz.
" one in each lower jaw, and two in each of
" the upper; the upper ſmall teeth are much
" worn by grinding, and both together are
" about an inch longer than thoſe of the un-
" der jaw; the upper teeth have a convexity
" which anſwers to the concavity of the un-
" der teeth, a circumſtance not obſerved by
" any one elſe." It is ſingular that Dr. Molyneux did not benefit by the remarks of Dr. Blair on this ſubject, moſt of which are very intereſting. Dr. Blair ſays, (page 116, 117 and
" 121,) In the upper jaw there are two teeth
" at each ſide, the back one of which does not
" grind, but ſerves, as it were a wedge, to keep
" the anterior firm in its place. Dr. Moulins
" takes no notice whether the hinder teeth of
" the upper jaw grind or not; but here as I
" have ſaid, not only both the hinder teeth are
" free from grinding, but alſo part of the fore
" teeth (tooth he means) of the left ſide. The
" ſituation of theſe teeth, for what I know, is
" peculiar

" peculiar to this animal. The teeth of the " lower jaw exceed thoſe of the upper about " two inches in length, by which it appears " that the motion of the lower jaw muſt be " very great in maſtication, and that the ele- " phant for the moſt part moveth the jaw " from behind to before; and ſcarcely from " one ſide to the other, as in animals that ru- " minate or chew the cud." This laſt obſervation of Dr. Blair's is perfectly juſt with reſpect to the motion of the under jaw in grinding, the ſockets and condyles of their jaws are beautifully conſtructed for this purpoſe, and although the upper teeth of the elephant deſcribed by Dr. Molyneux were longer than thoſe of the under, it very ſeldom happens ſo, if my recollection does not fail me. The motion of the under jaw of the beaver is ſimilar to that of the elephant, and although the rabbit, hare, &c. move their jaws likewiſe from behind to before, they poſſeſs in addition a conſiderable lateral motion. Dr. Blair adds, (page 121) " Before we quit the lower jaw, " I hope it will not be impertinent to enquire, " whether or no theſe *rudimenta dentium* may

" be ſuppoſed in proceſs of time to deſcend and " expel thoſe teeth already formed, and ſucceed " in their place." The ingenious Dr. Blair, having had but one elephant to examine, could not follow up this idea, he reaſons rather againſt the poſſibility of its taking place, and adds many arguments *pro* and *con* too numerous to inſert. Mr. Corſe, however, claims the entire merit of this diſcovery ; I think he ought to have noticed Dr. Blair's obſervations and ſhould not ſay, " The ingenious Dr. Blair, " far from ſuſpecting a regular ſucceſſion of " the grinders, attempts to prove ſuch ſucceſſi- " on to be impoſſible. He is equally erro- " neous in many other reſpects, (page 10)." Mr. Corſe however has (by the very great advantages he poſſeſſed, and the great induſtry exemplified in collecting ſo many heads of elephants of different ages,) thrown great light on this idea of Dr. Blair's, and cleared up the difficulties the older writers laboured under, reſpecting the number and ſituation of the teeth in different elephants, and obſerves, (page 13,) " An elephant may at one period " have only a ſingle grinder in each ſide of

" either jaw, (Mr. Corſe I ſuppoſe means in " uſe) at another period, there may be one and " part of a ſucceeding grinder; even a ſtill " greater variety in the appearance of the " grinders will take place according as the anterior one is more or leſs worn away and the " waſte ſupplied by its ſucceſſor." Theſe facts are beautifully exemplified in plates annexed to Mr. Corſe's work.

Mr. Tenon has publiſhed an account of his obſervations on the ſtructure and formation of the teeth of graminivorous animals, particularly the horſe, in the Mémoires De L'Inſtitut National des Sciences et Arts, Paris, Thermidor an. VI. anſwering to the year 1798 of our ſtile, ſome ſhort time previous to my theſis being printed. He notices the ſubſtance I have called the cruſta petroſa and calls it the *cortical oſſeux* or ſimply *cortical* *, the other two component parts he calls bone and enamel. He has taken conſiderable pains to aſcertain and point out the age of a horſe by the wearing down of his front teeth, the ſtructure of which he ſeems better acquainted with than that of the grinders, he gives drawings and ſections of the firſt but no ſections of the latter, and does not obſerve the difference between the upper and lower grinders; his work however contains many ingenious obſervations, and although he did not enter with ſufficient minuteneſs into either the ſtructure or manner of formation of their teeth, yet his work merits particular attention. With reſpect to the manner ~~and~~ of formation of the cruſta petroſa, he ſuppoſes the inveſting membrane becomes oſſified, he was aware however that the enamel was firſt formed, and ſays, (page 611) "Que "la formation de l'émail précède l'oſſification "de la membrane qui produit le cortical." I have aſſerted that the cruſta petroſa is merely a depoſition by the membrane; if the inveſting membrane was oſſified, the body of the tooth would not have an external perioſteum; the uſe of the cruſta petroſa and membrane I have frequently noticed. Mr. Tenon likewiſe obſerves, that the cruſta petroſa is ſofter than the bony part, and mentions it is to be noticed on the grinders of the elephant, &c.

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* Tom. premier. Sciences Mathematiques et Phyſiques, page 568.

This eſſay of Mr. Tenon's was in the library of a friend of mine in London ſome months previous to my viſiting that place in September 1799, whether Mr. Home ſaw it or not I cannot pretend to ſay, he has however hit on the idea of Mr. Tenon with reſpect to the formation of the cruſta petroſa, for he ſays, (page 7) "The intermediate ſubſtance which may be "called bone, was formed upon a ſpecies of "ligament ſituated immediately underneath "the gum." This ſubſtance (the cruſta petroſa) differs materially from bone, for it is neither fibrous nor lamellated, nor are thin ſections of it near as tranſparent as thoſe of bone, and although Mr. Home ſays, (page 5) "It proves to be ſimilar, "in its texture and formation to common "bone," yet in another part of his work he contradicts himſelf, for he well obſerves, (page 21) "In the bony part (ſcil. the cruſta petroſa) "there are no diſtinct fibres nor laminæ." The name I have annexed to this ſubſtance, in order to diſtinguiſh it from the other component parts, I do not think neceſſary to alter, if I did I would adopt that of the *oſſeous cruſt* given it by the ingenious Mr. Morton. Mr. Home endeavours to apologize for Mr. Hunter's not diſcovering the ſtructure and formation of the teeth of graminivorous animals by ſaying, (page 7 and 8) "To ſhow the figured "appearance on the grinding ſurface of horſes "teeth, Mr. Hunter rendered them black by "means of fire, which did not affect the ena-"mel, ſo that the white lines of the enamel were "beautifully diſtinct on the black ground: "but the bony part and the ſubſtance of the "tooth were equally coloured, and had an uni-"form appearance. The examination of theſe "preparations led him to believe, that the "horſe's tooth conſiſted of only two ſubſtan-"ces, the tooth itſelf and the enamel." Mr. Home's theory with reſpect to the formation of the cortex ſtriatus is rather curious, he ſays, (page 4) "This pulp is incloſed by a capſule, "the cavity of which, while the tooth is grow-"ing, is filled with a viſcid fluid, ſimilar to "the ſynovia of joints; and this fluid, by the "abſorption of the thinner parts, becomes in-

" ſpiſſated to a proper ſtate for cryſtallization, " ſo as to form the enamel, which adheres to " the ſurface of the tooth." I ſhall juſt aſk Mr. Home, what depoſits the mucilaginous fluid? to anſwer for him, the inveſting membrane. My ideas and the facts I have diſcovered on this ſubject are ſo frequently noticed in this eſſay, that they need no recapitulation. If Mr. Home's ideas were juſt, how does it happen that in the inciſores of ſome animals ſuch as the beaver, &c. only one ſide of the tooth is covered with the cortex ſtriatus, although the body of the tooth was ſurrounded by the inveſting membrane?

With reſpect to the different ſpecies of elephants, Mr. Corſe and Mr. Home might have referred to the ingenious obſervations introduced in Dr. Blair's work (page 110) by Tavernier on the difference between the elephants in India and thoſe of the iſland of Ceylon, and alſo Mr. Strachan's obſervations on the method of taking and taming wild elephants in Ceylon, and their different ſpecies * . With

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* Philoſophical Tranſactions abridged, Vol. V. Part II. page 176.

reſpect to Plate xvi. of Mr. Home's obſervations, which he gives to mark the difference between the Aſiatic and African elephant's tooth, he will meet drawings preciſely ſimilar given by Dr. F. Molyneux in the fourth Volume of the Philoſophical Tranſactions abridged, Part II. Plate III. page 252. The difference between the Aſiatic and African elephant is more fully explained by Cuvier * ; and Blumenbach has given drawings of a grinder of each in his objects of Natural Hiſtory. The grinder of the African elephant contains a much greater portion of the cruſta petroſa than the former, the appearance of the grinding ſurface is likewiſe different.

The grinders, &c. of an unknown animal ſuppoſed extinct, have been found in a foſſil ſtate intermixed with the tuſks and bones of elephants, near the banks of the river Ohio in

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* Mém. de L'Inſtit. Nat. Des Sciences, Paris, Fructidor An. VII. Mémoire ſur les Eſpèces D'Eléphans vivantes et foſſiles, par le Citoyen Cuvier. Pl. 1 and 2.

North America, accurate drawings of their full ſize and a deſcription of them are given by Peter Collinſon, F. R. S. in the fifty-ſeventh Volume of the Philoſophical Tranſactions for 1767, page 464. Theſe teeth were ſuppoſed to belong to another ſpecies of elephant, but as Mr. Collinſon well obſerves, when compared with the grinders of an elephant, they exhibit a very different appearance. They are in length generally about ſeven or eight inches, and from three and a half to four inches in breadth; they are formed nearly in a ſimilar manner to the human grinders, their bodies being entirely covered by the cortex ſtriatus, its thickneſs is twice greater than that on any other animal's tooth I have met with, being upwards of a quarter of an inch; the fibres of which it is compoſed are perfectly evident, and although it does not paſs down through the ſubſtance of the tooth, the grinding ſurface (owing to the irregular diſpoſition of the bony lamellæ) is very rugged. There is not the ſlighteſt appearance of a cruſta petroſa, ſo that the tooth conſiſts of but two ſubſtances. The appearance of the grinders induced the learned

Dr. William Hunter to rank this creature amongſt carnivorous animals, but the celebrated Camper differs from the Doctor, becauſe the inciſores and cuſpidati are wanting in this beaſt, which are the principal characteriſtics of carnivorous animals: Mr. Cuvier in ſupport of Camper's opinion refers to the rhinoceros, whoſe teeth in a certain degree reſemble thoſe we have been ſpeaking of, ſo that they ſuppoſe it lived on the branches of trees, &c. I think however it is moſt probable the creature lived alternately on animals and vegetables, and of courſe was omnivorous.

With reſpect to the formation of the tuſks of the elephant, Dr. Blair well obſerves, (page 111) "As to their ſtructure, I doubt not but they "have been compoſed at firſt of a mucilaginous ſubſtance, as teeth are; and that afterwards they augment by the appoſition of "ſeveral laminæ or ſtrata, according as the "animal increaſes in years." That they are compoſed of lamellæ placed one within the other, Sir Hans Sloane has clearly demonſtrated, and has given accurate drawings to ſupport his opinion *. He ſays, (page 24) " The ſtructure of theſe tuſks, and conſe- " quently of ivory in general, is layer upon " layer or coat upon coat, like the ſkins in an " onion, or rather the annual circles or rings " in trunks of trees." The outer lamella according to my obſervations is longeſt, the internal lamellæ become ſhorter and ſhorter, and the laſt formed is ſhorteſt.

Concerning the teeth of the Rhinoceros I have been incorrect, I have mentioned in my theſis (and introduced the remark into the preſent Eſſay, page 87,) that I obſerved the cruſta petroſa on its teeth: this was from recollection, three years intervening ſince I ſaw one in London which was ſtuffed, and could not meet with one of their teeth in Edinburgh. They are as Mr. Home mentions, (page 19) compoſed only of two ſubſtances, ſcil. bone and the cortex ſtriatus.

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* Philoſophical Tranſactions abridged, Vol. VI. Part III. Page 24. Plate III.

Mr. Home has not deſcribed the ſtructure of the cow's grinder as accurately as the ingenious Mr. Clift drew it, he has repreſented the tooth as it really is, in general compoſed of four different ſubſtances, (Tab. xx. Fig. 2.) the internal cavities filled with adventitious matter are drawn black, the bony part of a lighter colour, the windings of the cortex ſtriatus are eaſily diſtinguiſhed, and the cruſta petroſa on the external ſides of the tooth is repreſented white. Mr. Home obſerves, that a cow's tooth conſiſts of but three ſubſtances, and that the internal cavities are filled by the cruſta petroſa or what he calls bone. This is an egregious error, and in one interview I had with him in London I could not perſuade him to the contrary, although he told me he had ſeen my theſis and obſervations on this ſubject. A ſimilar and greater miſtake he has committed with reſpect to the grinders of the ſheep, for their interſtices are likewiſe drawn by Mr. Clift black, as they really are, (Tab. xx. Fig. 3.) being conſtantly filled with particles of graſs, clay, &c. Yet Mr. Home ſays they are filled by the cruſta petroſa, and adds, there is none of it on the outſide of the tooth. Mr. Home did not underſtand that in young animals it eaſily chips off as I formerly mentioned, which was moſt probably the caſe in the ſpecimen he examined, and as ſheep are commonly killed early in life and alſo cows, the quantity of the cruſta petroſa on their teeth cannot be in proportion to that on an old horſe's tooth, with which Mr. Home compares them. And in the horſe's tooth where part of the cavity had been filled with the particles of food, &c. Mr. Home obſerves in explanation of Tab. xx. Fig. 1. "The two "holes were probably to give paſſage to arte-"ries, and were enlarged by the food falling "into them, *and wearing away their ſides.*" Theſe are original remarks indeed.

I ſhall now take the liberty of referring the Right Hon. and Hon. the Members of the Royal Society to my Theſis, which (by their letter of thanks, dated London, May 9, 1799, and ſigned by their ſecretary, E. W. Gray, Eſq.) they received from me. And with the teſtimony of Dr. Monro, ſen. in ſupport of my priority of claim, I ſhall conclude this ſubject.

SIR,

In November laſt I received a letter from you, dated Dublin, October 25, 1800, in which you aſked me to mention what you ſhowed me, in October 1798, relating to the ſtructure of the teeth in the elephant. In anſwer to this, I can have no heſitation in declaring,

That in autumn 1798, one of the molares of an elephant, which had been for a conſiderable time in my poſſeſſion, was, at your requeſt, ſawed perpendicularly.—That a drawing and engraving of this, of its full ſize were executed by your direction.—That in October 1798, you gave me a proof of this table, which I preſerved and which is now before me. On one corner of it I find engraved—*drawn by William Alſton*, and on the other corner *engraved by R. Scott*, and under it *publiſhed as the act directs* 1798, *by R. Blake*,

Blake, *M. D.* You had painted thoſe parts of the tooth, which are outſide the plates, of enamel of a yellow colour ; and you had written on the margin, below the table, *The yellow parts repreſent the cruſta petroſa.* *R. B.*

One half of the tooth is ſtill in my poſſeſſion, and, with it, a thin ſection from the ſame tooth, in which I have made the diſtinctions of *enamel*, *oſſeous ſubſtance*, and what you called cruſta petroſa. more evident, by having expoſed it to heat.

I am, Sir,
Your moſt obedient ſervant,
Alexander Munro, *Sen.*

Edinburgh, *Jan.* 25, 1801.

For Dr. BLAKE.

EXPLANATION

OF THE

FIGURES.

TABLE I.

Fig. 1. Repreſents the rudiments of the teeth of a fœtus, about four months after conception, taken from the left ſide of the lower jaw, a. a. b. c. c. the membranes, &c. of the temporary teeth, a. a. the membranes of the inciſores, b. the membrane of the cuſpidatus, c. c. thoſe of the grinders, d. the membrane of the anterior permanent grinder, e. the gum, f. the veſſels &c. g. g. h. i. k. the bony ſhells taken out of the membranes, g. g. the ſhells of the inciſores, h. the ſhell of the cuſpidatus, i. thoſe of the anterior grinder, which commenced by two points of oſſification, k. one ſhell only which was at this period formed on the poſterior grinder.

Fig. 2. Repreſents the left ſide of the lower jaw of a fœtus about five months; the internal plate of the alveolar proceſs being cut away, a. a. b. c. c. the membranes of the inciſores, cuſpidatus and temporary grinders, a. a. the membranes of the inciſores, b. the membrane of the cuſpidatus, c. c. thoſe of the grinders, d. the membrane of the anterior permanent grinder, e. the veſſels, &c.

Fig. 3. Repreſents an internal view of the rudiments of the teeth, taken from the right ſide of the upper jaw of a fœtus, between eight and nine months old, a. a. b. c. c. the rudiments of the temporary inciſores, cuſpidatus and grinders, d. the membrane of the anterior permanent grinder, e. e. f. the incipient ſacs of ſome of the permanent teeth, e. e. thoſe of the inciſores, f. the ſac of the cuſpidatus, g. g. the gum, h. h. i. k. k. the ſhells of the temporary teeth ſeparated from the membranes, h. h. thoſe of the inciſores, i. the ſhell of the cuſpidatus, k. k. the ſhells of the grinders, l. one ſhell which had commenced on the anterior permanent grinder.

Fig. 4. 5, and 6. Different ſections of the lower jaw, and rudiments of the teeth of a child about ſeven or eight months after birth. This preparation had been preſerved in ſpirits of wine, ſo that the parts are very much contracted, it was not injected with wax, but made with an intention of ſhowing the nerves entering the pulps; the condyles, &c. have been entirely cut away.

Fig. 4. Repreſents an external view of it, a. a. the middle temporary inciſores, which had nearly penetrated

the gum, it appears ſlightly elevated over them, b. b. their roots, c. one of the lateral inciſores, d. the cuſpidatus, e. part of the ſac of the permanent cuſpidatus, f. f. the temporary grinders, g. the anterior permanent grinder, h. the incipient ſac of the middle permanent grinder, i. the veſſels, nerve, &c.

Fig. 5. An internal view of the ſame preparation: in order to ſhow the ſacs of the permanent teeth, part of the alveolar proceſſes have been cut away, a. a. the gum ſlightly elevated over the middle temporary inciſores, b. b. the connexion, membranes, &c. of the middle permanent inciſores, c. c. thoſe of the lateral inciſores, d. d. thoſe of the cuſpidati, e. the commencement of the ſac of the anterior bicuſpis, f. g. the temporary grinders.

Fig. 6. a. the ſac of one of the lateral inciſores turned up, to ſhow the intimate connexion which ſubſiſts between it and the membrane b. of the temporary inciſor, c. the ſac of the middle permanent inciſor, d. the gum elevated over the middle temporary inciſores, e. the ſac of the permanent cuſpidatus.

Fig. 7. Part of the under jaw of a child about fifteen months old, in which the veſſels and nerve ſoon after they entered the common foramen of the jaw together, ſeparated, a. the entrance of the veſſels and nerve, b. b. the nerve, a ſmall branch of the artery accompanies the nerve to nouriſh it, c. the principal branch of the artery, d. the anterior permanent grinder, e. the

ſac of the middle permanent grinder, which appears very much contracted, being preſerved in ſpirits of turpentine, f. the ſocket of the poſterior temporary grinder which had been taken out, g. the anterior temporary grinder, it had appeared through the gum. The ſituation and connexion of the permanent teeth were not preſerved in this preparation.

Fig. 8. One of the inciſores of a young pig, the veſſels of which were filled with fine injection; part of the bony ſhell is cut away, to ſhow the membrane of the pulp and the veſſels expanded on its ſurface, a. the membrane and veſſels, b. their entrance into the ſhell.

TABLE II.

Fig. 1. and 2. An internal view of the jaws and teeth of a child about four years old, the alveolar proceſſes being cut away; only one ſide of each is perfectly repreſented.

Fig. 1. The upper jaw, a. a. b. b. c. c. d. d. e. e. the temporary teeth, a. a. the middle inciſores, b. b. the lateral, c. c. the cuſpidati, d. d. the anterior or ſmall grinders, e. e. the poſterior or large grinders, f. f. f. the *foramen inciſivum, ſeptum palati,* &c. g. g. h. h. i k. l. m. the rudiments of the permanent teeth, g. g. the middle inciſores encloſed in their proper membranes, which paſs upwards through the ſmall holes and are laterally connected to the membranes of the middle temporary

inciſores, the internal part of their ſockets is not entirely cut away, h. h. the lateral inciſores, membranes and connexion, i. i. the membranes, &c. of the bicuſpides, k. the rudiment of the cuſpidatus preſſed out of the circle and ſituated very deep in the jaw ; its membrane however paſſes up to the temporary cuſpidatus, l. the anterior grinder covered by its membrane, the gum has been removed, m. the middle grinder, n. n. the pterygoid proceſſes, o. o. the poſterior *nares*, p. the gum &c. of the right ſide not removed.

Fig. 2. The under jaw, a. a. a. a. b. b. c. c. d. the temporary teeth, a. a. a. a. the inciſores, b. b. the cuſpidati, c. c. the anterior grinders, d. the poſterior grinder of the right ſide ; e. e. f. f. g. g. h. h. h. h. i. i. k. l. the membranes and connexion of the permanent teeth, e. e. the membranes, &c. of the middle inciſores, f. f. thoſe of the lateral inciſores, g. g. the ſame of the cuſpidati, h. h. h. h. the membranes, &c. of the bicuſpides, i. i. thoſe of the anterior grinders, k. the membrane, &c. of the middle grinder, m. the connecting membrane and gum paſſing back over the bony partition from the anterior to the middle grinder, at the poſterior part of which, the veſſels at l. enter to form the wiſdom tooth, n. the perioſteum, veſſels and nerves, entering the foramen of the jaw and diſtributing branches to the teeth, nearly at o. the nerve and veſſels divide into two branches, the principal of which paſs out to the lower lip, the others paſs on to the roots of the inciſores, &c. p. p. p. the ſpongy ſubſtance of the jaw.

Fig. 3. The temporary cuſpidatus of a child about eighteen months old, ſurrounded by its proper membrane and the membrane of the permanent cuſpidatus intimately connected with it, a. the temporary tooth, b. the connexion, c. the ſac of the permanent tooth, the ſhell which was formed in it had been removed.

Fig. 4. An under temporary inciſor of the ſame child, which had appeared through the gum ; the connecting membrane and ſac of the permanent tooth are repreſented, the bony ſhell had been removed, a. the body of the temporary tooth, b. the connexion, c. the ſac.

Fig. 5. A ſection of the under jaw of a child about four years of age, to ſhow that the temporary and permanent inciſores are at that period contained in perfectly diſtinct ſockets, a. the body of the temporary inciſor, b. its root, c. the ſac and connecting membrane of the permanent inciſor paſſing through the ſmall hole at d. and connected to the neck of the temporary tooth, the gum is turned up at e. to ſhow the connexion, f. the ſpongy ſubſtance of the jaw.

TABLE III.

Fig. 1. The jaws of a child about ſeven or eight years old, to illuſtrate the increaſe of their arches, a. a. b. b. b. b. c. c. c. c. the temporary teeth of both jaws, a. a. the lateral inciſores of the upper jaw, b. b. b.

b. b. b. b. the cuſpidati, c. c. c. c. the grinders. d. d. d. d. d. d. e. e. f. f. g. g. g. g. h. h. i. the permanent teeth, d. d. d. d. d. d. the inciſores which had juſt appeared through the gum, e. e. the lateral inciſores of the upper jaw, f. f. the cuſpidati, g. g. g. g. the bicuſpides, h. h. the anterior grinders nearly perfect, and at their proper height above the level of the gum, i. the middle grinder.

Fig. 2. The upper jaw of a fœtus about nine months, a. a. a. a. b. b. c. c. d. d. the ſockets of the temporary teeth, a. a. a. a. the ſockets of the inciſores, b. b. thoſe of the cuſpidati, c. c. thoſe of the ſmall grinders, d. d. the ſockets of the large grinders, in which the membranes of the anterior permanent grinders were contained, e. e. E. E. f. f. the incipient ſockets of ſome of the permanent teeth, e. e. the ſockets of the middle inciſores, E. E. thoſe of the lateral, f. f. thoſe of the cuſpidati, g. g. the palate proceſſes, h. h. the *oſſa palati*, i. i. i. the external plate of the alveolar proceſſes.

Fig. 3. A carious temporary grinder, and that part of the under jaw which contained the rudiment of the bicuſpis, ſloughed off from the ſound parts, occaſioned by repeated gum boils, a. one of the roots and part of the body of the grinder, b. part of the jaw, c. the ſurface where the ſecond root of the grinder was ſituated, d. the ſocket, e. the bicuſpis, removed from the ſocket.

Fig. 4. A lateral temporary inciſor and cuſpidatus joined together, one cavity ſerved both for the admiſſion of veſſels, &c. a. the inciſor, b. the cuſpidatus, c. the cavity which contained the pulp, part of the root had been abſorbed ſo as to expoſe the cavity.

Fig. 5. An internal view of a middle and lateral permanent inciſor, completely joined together, a. the middle one, b. the lateral, c. a protuberance of the cortex ſtriatus at their junction, d. a diſeaſed hole, e. the root.

Fig. 6. An external view of the ſame teeth, a. the body, on which no trace is left of their junction, b. the root.

Fig. 7. A permanent cuſpidatus of the right ſide, upper jaw, with a remarkable protuberance of the cortex ſtriatus on it, about which, a ſubſtance ſimilar to the cruſta petroſa of graminivorous animals was depoſited, a. the protuberance of the cortex ſtriatus, b. b. b. b. the cruſta petroſa, c. the perfect point of the tooth.

Fig. 8. An external view of the ſame tooth, a. the perfect body, b. b. the cruſta petroſa.

Fig 9. The right ſide of the under jaw of a ſquirrel, the internal plate of the alveolar proceſſes being cut away, to ſhow the great extent of the inciſor, a. a. a. the bony part of the inciſor extending back to the root of the coronoid proceſs f. b. b. the cortex ſtriatus,

c. c. c. c. the grinders, d. the cavity of the jaw for the admiſſion of veſſels, e. the condyle, g. the angle of the jaw.

Fig. 10. A permanent inciſor of the under jaw, the upper part of the cortex ſtriatus being imperfectly formed and pitted, a. the imperfect part of the body, b. a ſmall part of the cortex ſtriatus perfectly formed, c. the bony part much extended.

Fig. 11. The body of a middle permanent inciſor of the upper jaw, to ſhow in what manner the earthy matter of the cortex ſtriatus is gradually depoſited, and afterwards cryſtallized in ranges of fibres, a. the courſe of the fibres.

Fig. 12. The root of a carious bicuſpis of the under jaw, its membrane had been much enlarged and formed into a ſac, which ſuppurated and burſt externally, a. a. the root, b. b. the ſac laid open.

TABLE IV.

Fig. 1, 2, 3, 4, 5, 6 and 7, Repreſent the progreſs of oſſification, of the anterior permanent grinder of the lower jaw. Fig. 1. Five points of oſſification. Fig. 2. The ſhells united and turned up ſo as to expoſe the cavity. Fig. 3. The cavity divided into two openings by the incipient roots a. b. the neck. Fig. 4. a. the roots more advanced. Fig. 5. Shows the pulp a. a. advancing more rapidly than the oſſification, b. the membrane intended to form the cortex ſtriatus, not entirely waſted, this tooth had appeared through the gum. Fig. 6. The roots more advanced, with part of the body at a. pitted or indented. Fig. 7. The roots perfectly formed, in one of which the veſſels entered by two openings at a. this root was formed as Euſtachius mentions, the other had but one opening.

Fig. 8, 9, 10, 11, 12 and 13, Show the progreſs of oſſification of the anterior permanent grinder of the upper jaw. Fig. 8. Five points of oſſification not as yet perfectly joined. Fig. 9. The ſhells united and turned up. Fig. 10. The cavity divided into three openings by the incipient roots a. Fig. 11. a. The roots more advanced. Fig. 12. a. a. a. The pulp advancing more rapidly than the oſſification, b. the neck to which the inveſting membrane firmly adheres, it looſely ſurrounds the body of the tooth and is at c. held out a little from the tooth by a pin. Fig. 13. The roots perfectly formed, with but one hole in the point of each for the admiſſion of veſſels.

Fig. 14, 15, 16, 17, 18 and 19. A ſimilar ſeries of the bicuſpides. Fig. 19. A bicuſpis of the upper-jaw with two roots, which is commonly the caſe.

Fig. 20, 21, 22, 23, 24 and 25. Different ſections of the permanent teeth, to explain the ſtructure of the cortex ſtriatus and bony part. a. a. a. a. a. a. the internal cavities of all the teeth, which contained the pulps, veſſels, &c. b. b. b. b. b. b. their bony part, the lines which repreſent their bony lamellæ become ſhorter and ſhorter towards the internal part, c. c. c. c. c. c. their cortex ſtriatus, the fibres of which it is compoſed, and alſo its thickneſs are accurately repreſented. Fig. 21 and 22, d. d. the commencement of the roots, to demonſtrate that the internal cavities a. a. decreaſe more rapidly after their commencement.

Fig. 26, 27, 28 and 29, different temporary teeth, to ſhow the waſting of their roots by abſorption, a. a. a. a. the parts waſted.

Fig. 30. A permanent grinder of the under jaw, the cortex ſtriatus of which was imperfectly formed, and remarkably pitted, a. a. four very deep pits.

Fig. 31. A grinder of the under jaw, the pulp of which did not ſeparate into proceſſes, ſo that only one root was formed, a. the cavity which contained the pulp.

Fig. 32, 33, 34 and 35, Different ſections of jaws, to ſhow the manner in which the permanent teeth appear, partly in their own ſockets and partly in the ſockets of the temporary teeth, and alſo how by the reſiſtance of the roots of the temporary, the permanent teeth appear irregularly.

Fig. 32. a. The ſpongy part of the jaw, b. a permanent inciſor paſſing into the ſocket of the temporary, c. the ſocket of the temporary tooth which had been ſhed, c. the hole by which the membranes were connected, d. the ſocket of the lateral temporary inciſor.

Fig. 33. a. The ſpongy part of the jaw, b. the permanent inciſor appearing more internally than the hole c. through which the membranes were connected, d. the ſocket of the lateral temporary inciſor, e. the middle temporary inciſor, its root was not waſted.

Fig. 34. a. The ſpongy part of the jaw, b. the permanent inciſor, which appeared at the internal part of the mouth on account of the reſiſtance of the temporary cuſpidatus d. c. part of the ſocket of the lateral temporary inciſor.

Fig. 35. a. The ſpongy ſuſtance of the jaw, b. the bicuſpis paſſing partly into the ſocket of the temporary grinder which was taken out to ſhow the bony partition c. not yet abſorbed, d. the ſocket of one of the roots of the grinder.

TABLE V.

Fig. 1. Repreſents the right ſide of the lower jaw of a fœtus calf about three months old, the internal plate of the alveolar proceſſes being cut away, a. a. a. a. the membranes, &c. of the inciſores, b. b. the membranes of the two anterior ſmall grinders, c. the membrane of the firſt great grinder, d. the ſame of the ſecond beginning to form, e. e. e. e. e. e. the connexion of the membranes, gum, veſſels, &c.

Fig. 2. The pulp and bony ſhells of the firſt great grinder of the ſame calf, the membranes being removed, oſſification commenced on ſix different points of the pulp, in this view three only of the ſhells can be ſeen, a. the pulp, b. b. b. the ſhells, c. the veſſels, &c.

Fig. 3. One of the ſhells removed, a. the external part, b. the cavity, in which the pulp was contained.

Fig. 4. A grinder more perfect, which commenced by four points of oſſification, the ſhells were joined, a. a. the body of the tooth, b. b. the two internal cavities into which duplicatures of the inveſting membrane paſſed, to form the cortex ſtriatus, c. an additional proceſs.

Fig. 5. A grinder formed of ſix ſhells, the grinding ſurface turned downwards, to ſhow the junction of the internal plates of the ſhells and the manner in which the membranes are ſeparated from the pulp, a. a. the junction of four of the ſhells perfect, b. the junction of the other two not as yet perfect, a cavity is ſeen, where the membrane and pulp were ſtill in contact, c. c. protuberances occaſioned by the additional proceſſes, d. the body of the tooth.

Fig. 6. The great grinder of a fœtus calf about four months, ſurrounded by its membranes, a. a. the external and vaſcular lamella turned upwards, b. b. the internal lamella, in which I could not diſcover blood veſſels, part of it is turned up with the former to ſhow one

of the bony ſhells c. The veſſels, &c. are repreſented at d.

Fig. 7. A tranſverſe ſection of a temporary grinder nearly perfect, a. a. a. the inveſting membrane paſſing over and down between the ſhells to form the internal plates of the cortex ſtriatus, the fibres of which are ſeen in contact with the membrane, the pulp b. b. in contact with the bony part, which is repreſented white, at c. the ſides of the ſhells approach ſo cloſe together that the cortex ſtriatus appears penniform, d. the commencement of the roots.

Fig. 8. A grinder which had partly appeared through the gum, a. a. the points which had appeared, b. b. the gum turned upwards, a few fibres of which, not being as yet waſted are ſhown paſſing down between the ſhells, to nouriſh the membrane in the hollows, c. c. the lower part of the membrane, it appears very thin on the roots, and veſſels are ſhown paſſing upwards from the roots to nouriſh the membrane.

Fig. 9. A grinder which had entirely appeared through the gum, a. a. a. the membrane and part of the gum in the hollows dead, the nouriſhment being cut off by the appearance of the tooth.

Fig 10. The upper ſurface of a cow's grinder which commenced by four points of oſſification, when perfect the bony part could not be obſerved, but the upper part of the cortex ſtriatus being worn away, the bone now

appears between its plates : the white lines repreſent the cortex ſtriatus, a. a. a. a. a. the bony part, b. b. b. the hollows into which the membrane paſſed filled with a dark brown ſpongy ſubſtance; c. c. the ſides which were contiguous to the other teeth, d. d. the cruſta petroſa, this tooth conſiſts of four different ſubſtances.

Fig. 11. A tranſverſe ſection of a ſimilar tooth to ſhow the four component parts, &c. the upper part and connexion of the cortex ſtriatus being worn away, a. a. a. a. the extent, windings and arrangement of the fibres of the cortex ſtriatus accurately repreſented, b. the cavity filled with the adventitious matter, c. c. c. the bony part and alſo the hollows where the pulp was ſituated, d. the junction of the external plates of the ſhells, e. e. the cruſta petroſa.

Fig. 12. The upper ſurface of a horſe's grinder poliſhed to ſhow nearly the ſame ſtructure, the white lines are the cortex ſtriatus, a. a. a. a. the bony part, b. b. the hollows filled partly by the cruſta petroſa and partly with the adventitious matter, c. c. the ſides which were contiguous to the other teeth, at one ſide the cortex ſtriatus is very thin, and at both the cruſta petroſa is in a great meaſure wanting, d. d. d. d. the cruſta petroſa.

TABLE VI.

Fig. 1. An internal view of the teeth and part of the jaw of a ſkate, a. two or three of the front ranges of

teeth worn down by grinding, b. four ranges perfectly formed and paſſing upwards into the place of the former, c. four or five ranges imperfectly formed and covered by their proper membranes, d. part of the jaw.

Fig. 2. An internal view of one of the teeth removed, a. the body, b. the roots to which the ligaments were attached.

Fig. 3. An internal view of part of the jaw and teeth of the *Lophius piſcatorius* to ſhow the elaſtic cartilages to which the teeth are annexed, a. the cartilages, b. part of the jaw.

Fig. 4. One of the teeth removed, a. the bony part of the tooth which was not connected to the jaw in order to allow of free motion, b. the elaſtic cartilages.

Fig. 5. An internal view of part of the jaw and teeth of the common ſhark, a. a. two teeth of the firſt range perfect, b. a ſpace where one of the teeth was torn away or naturally ſhed and the tooth c. from the range immediately underneath turning up to occupy its place, ſeveral of the lower ranges are obſerved imperfectly formed, their membranes were cut away, d. part of the membranes and jaw.

TABLE VII.

Fig. 1. An inſtrument for lancing the gums of children, it ought to be flat and ſharp from a. to b. the reſt ſhould be ſmooth and round.

Fig. 2. An inſtrument for taking out the decayed roots of teeth.

Fig. 3. A curved forceps for taking out the temporary teeth, c. a rugged groove to prevent the inſtrument ſlipping off the tooth.

SUPPLEMENTARY PLATES.

TABLE VIII.

A longitudinal ſection of an elephant's grinder to ſhow its three component parts and the beautiful manner in which the plates of the cortex ſtriatus wind through its internal ſubſtance, a. the proper bony part of the tooth which appears wavy, b. the hole leading into the cavity of the tooth for the admiſſion of veſſels, &c. to nouriſh the pulp and form the bony part, one continued line of the cortex ſtriatus can be traced beginning at e. until its connexion is cut off as at c. by grinding, from c. to c. the portion of the grinding ſurface which came into uſe, a. is at the anterior part of the tooth, 1, 2, 3, 4, 5, &c. repreſent the cruſta petroſa paſſing over and down between the ſhells as far as the junction of the plates of the cortex ſtriatus, d. d. d. the junction of the ſhells. In looking over the grinding ſurface of the tooth from 12. to 4. we can ſcarcely diſcern whether the cruſta petroſa wears faſter than the bony part or not, in the ſection likewiſe given by Mr. Corſe after my plan, we cannot ſay which of the two ſubſtances wears down faſteſt, the ridges of the cortex ſtriatus however are ſufficiently obvious.

TABLE IX.

Fig. 1. Repreſents a longitudinal ſection of one of the upper grinders of an elephant in an incipient ſtate, about one third leſs than its natural ſize, a. a. a. a. &c. the cruſta petroſa paſſing over and down between the proceſſes until checked by the junction of the bony ſhells and plates of the cortex ſtriatus. b. b. b. b. &c. the proper bony part of the tooth upon which the fibres of the cortex ſtriatus are arranged, one continued winding line of which can be traced commencing at e. and terminating at f. where the alternate edges of the bony ſhells were not as yet joined, c. c. two ſhells ſtill ſeparate from the anterior part of the tooth, a ſufficient quantity of the cruſta petroſa not being depoſited to fill up the interſtices between them, ſix or eight ſimilar ſhells but progreſſively ſmaller were forming, d. the junction of the edges of two ſhells, above which a ſmall ſpace is obſerved which had not been at this period filled by the cruſta petroſa, f. g. h. i. the alternate edges of the bony ſhells which would have been united as oſſification advanced.

Fig. 2. A front view of one of the ſhells very much diminiſhed in ſize but accurately copied from fig. 90. of Dr. Blair's eſſay, his deſcription of it is as follows, "One of the rudiments of the teeth of the lower jaw, "a. its upper part, which is hard, ſolid, and white, b. "its middle part diſtinguiſhed by ſeveral ridges and "furrows, c. its lower part, which is hollow and con-"tained the blood veſſels and nerve, &c."

Fig. 3. An internal view of the under jaw of a beaver, the inner plate of the jaw being cut away to expoſe the great inciſor, a. a. a. the bony part, b. b. b. the cortex ſtriatus, g. the hollow ſhell which contained the pulp, veſſels, &c. c. d. e. f. the grinders, one continued line of the cortex ſtriatus can be traced round each except at f. where an additional point was added, the cruſta petroſa is placed externally, h. the common *foramen* of the jaw, i. the coronoid proceſs, k. the condyle.

Fig. 4. One of the grinders removed, a. the grinding ſurface, b. the convoluted ſhell which contained the pulp, &c. no appearance of roots as yet forming.

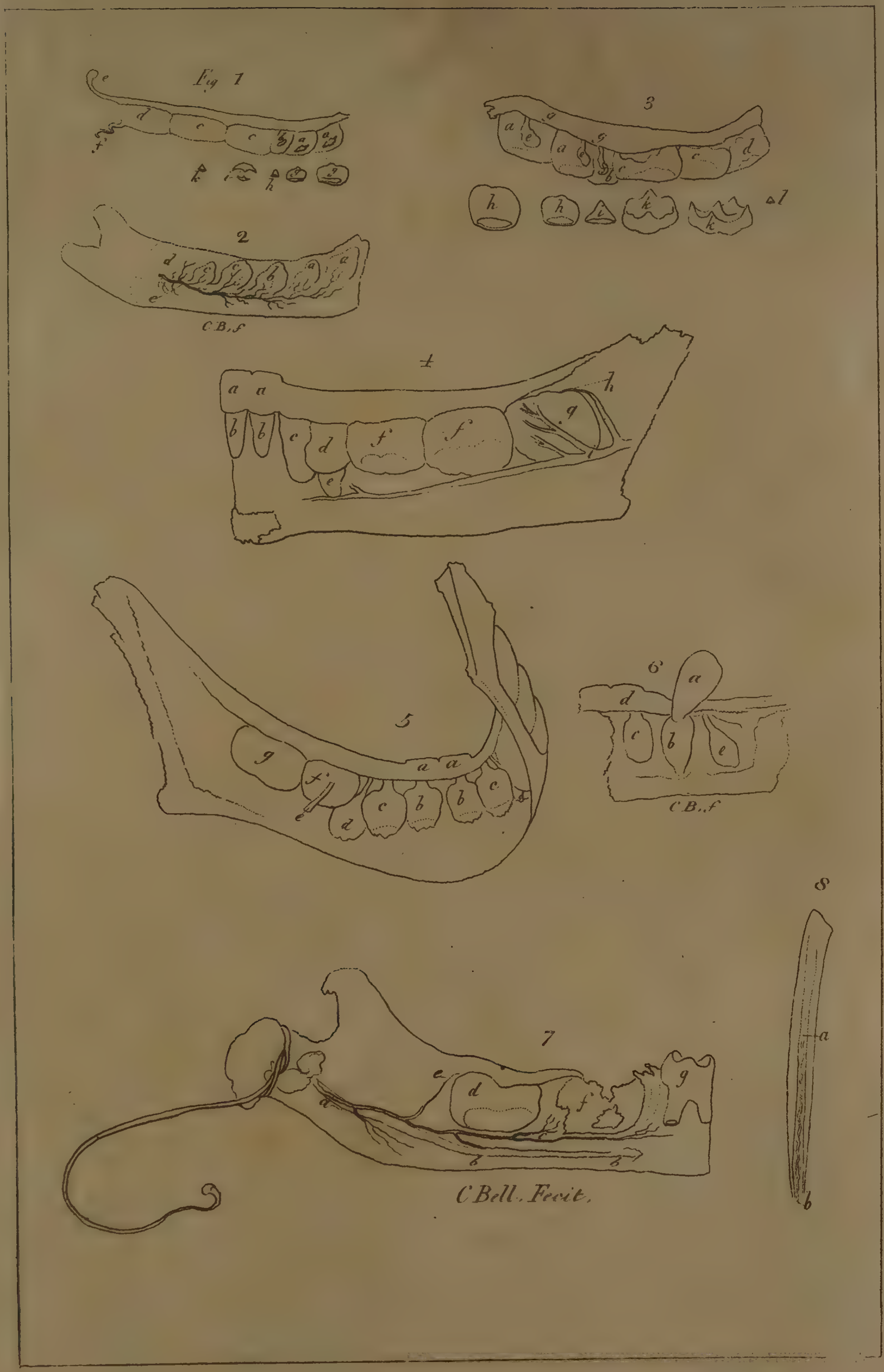
Fig. 5. An under grinder of the horſe previous to its having appeared through the gum, a. a. its points entirely covered by the cruſta petroſa.

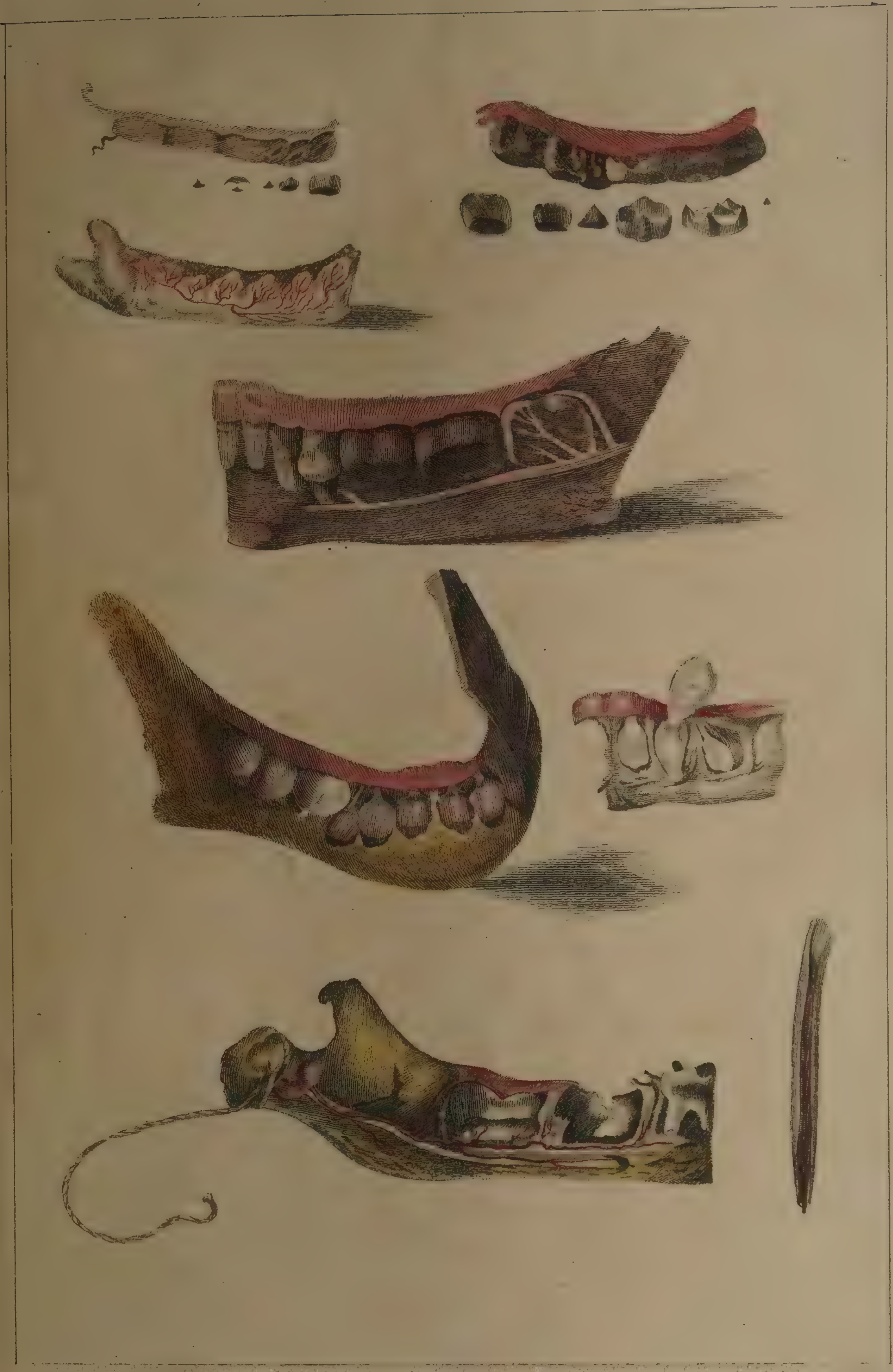
Fig. 6. An under grinder of a larger horſe, which had appeared, and the points worn off by grinding, ſo

that one continued line of the cortex ſtriatus can be traced, within which, only the bony part b. is contained, a. the cruſta petroſa.

FINIS.

Tab. I





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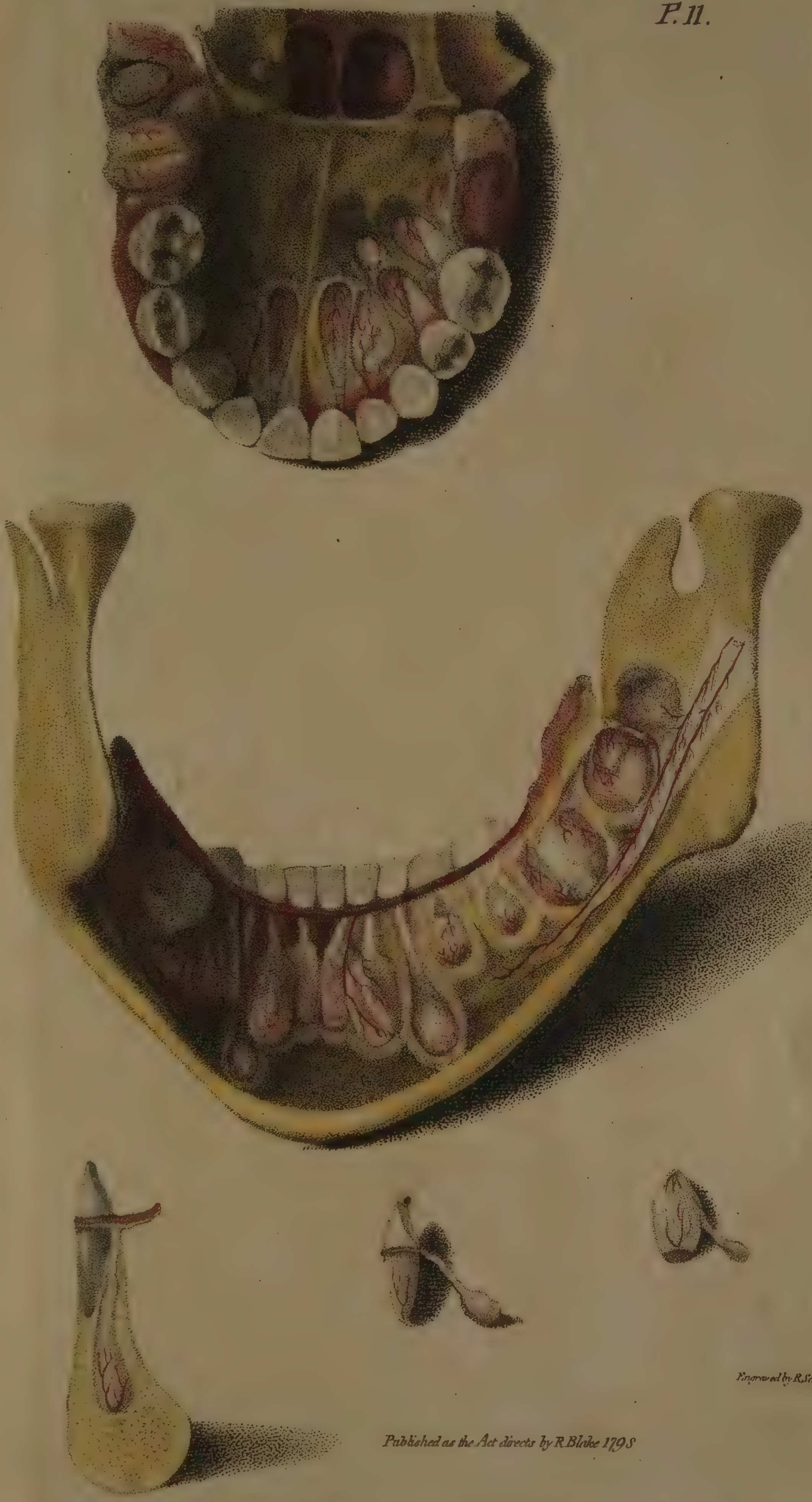

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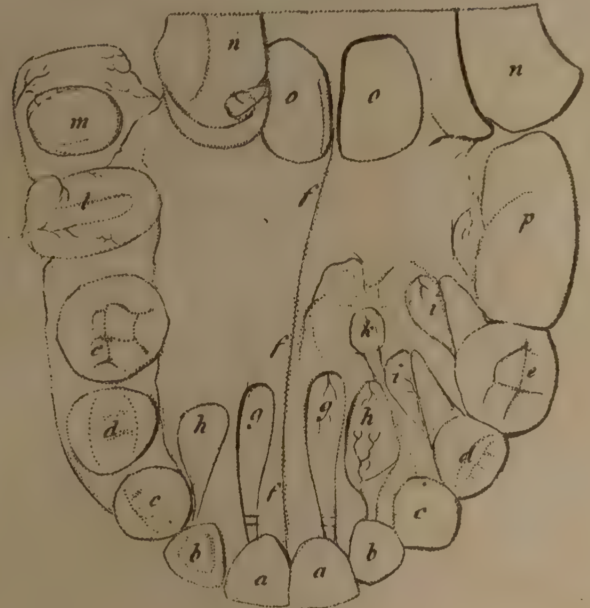

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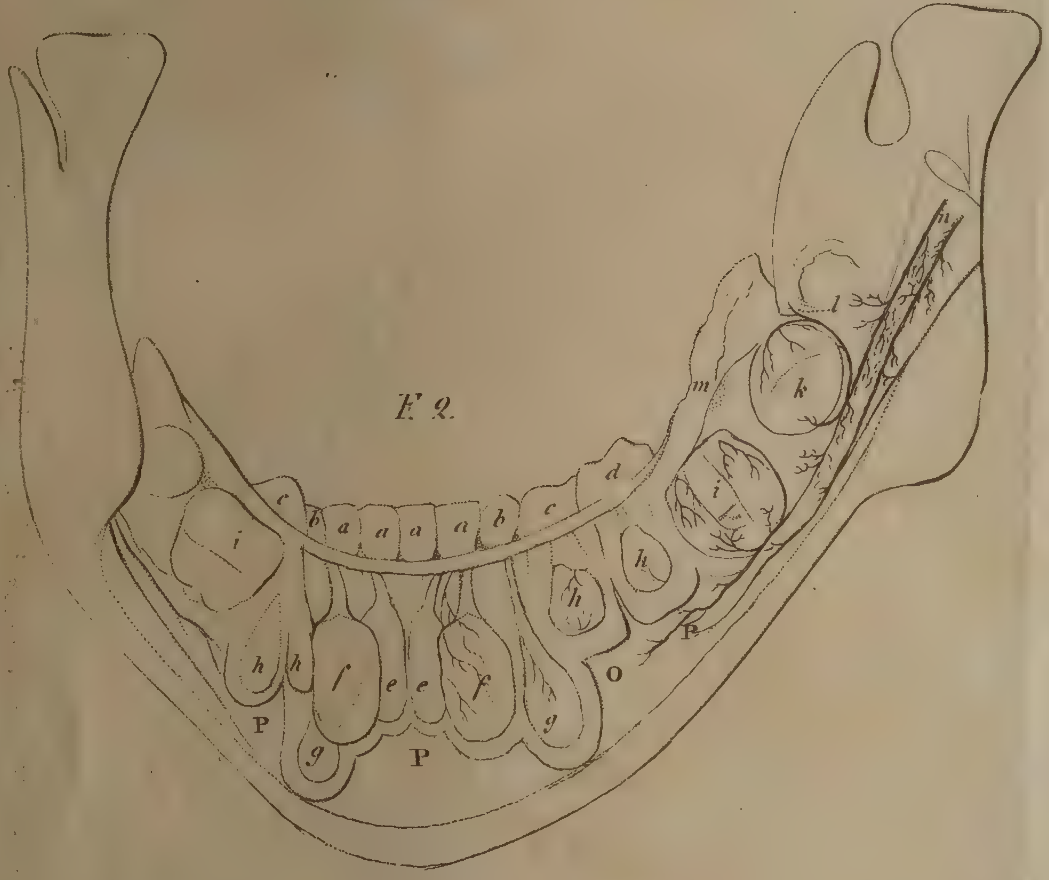

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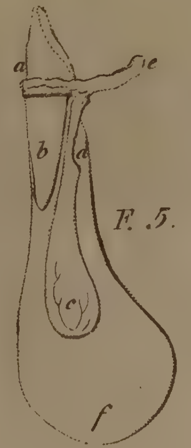

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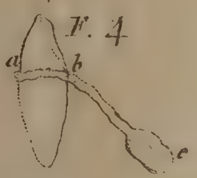

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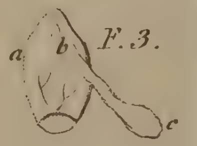

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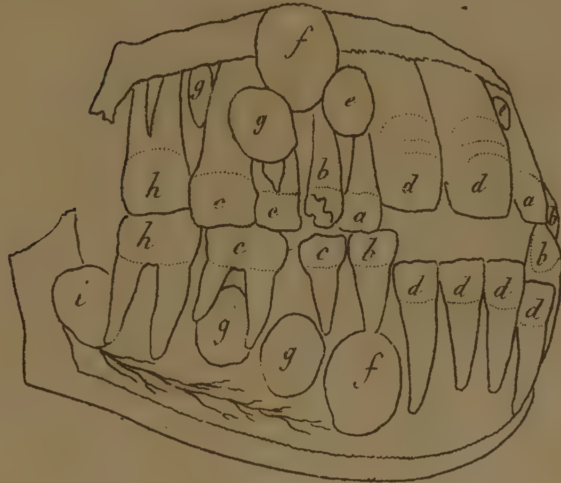

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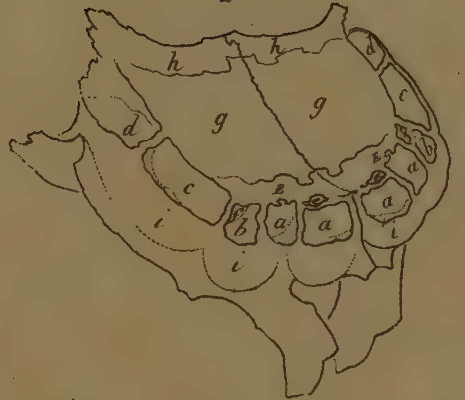

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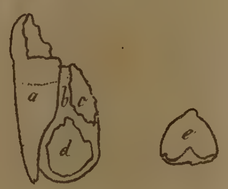

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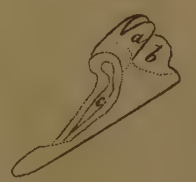

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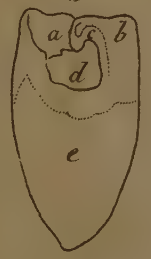

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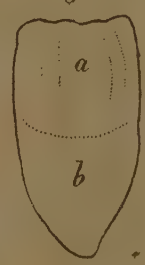

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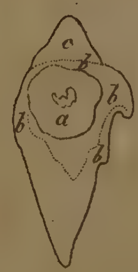

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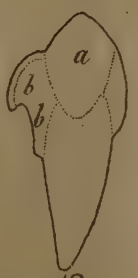

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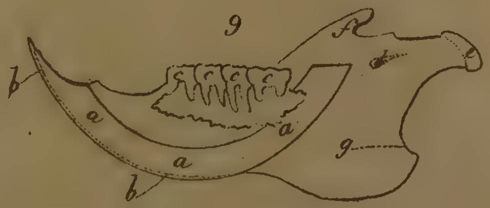

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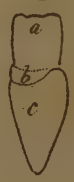

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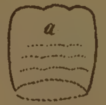

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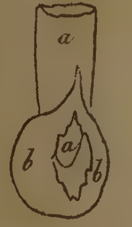

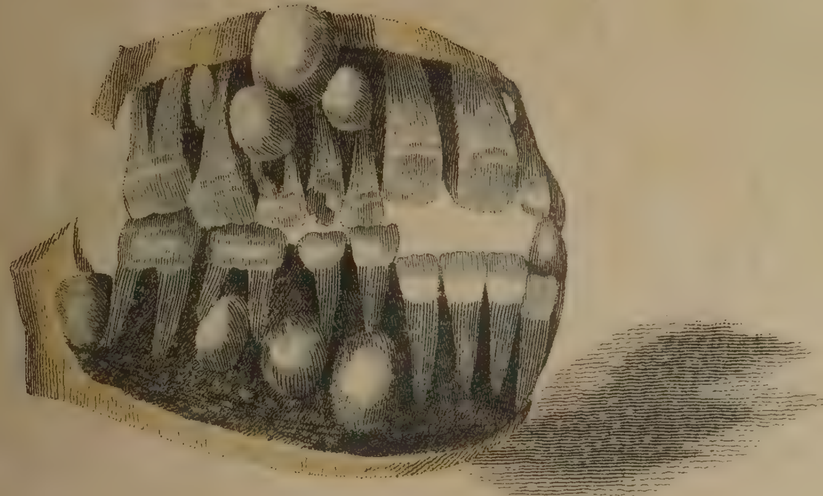

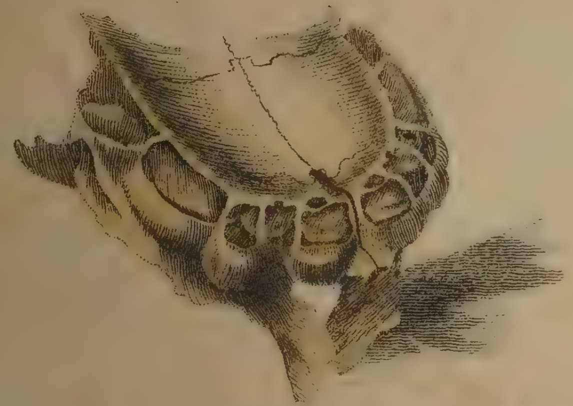

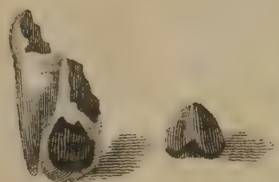

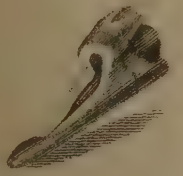

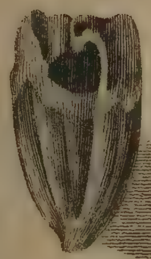

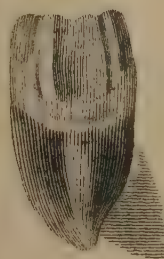

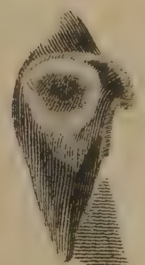

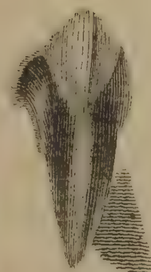

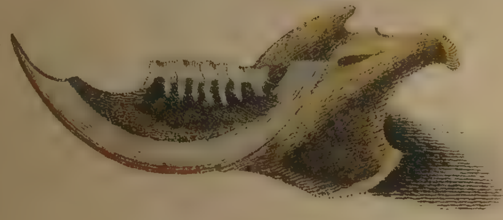

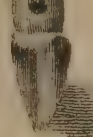

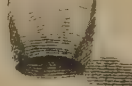

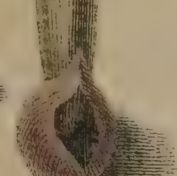

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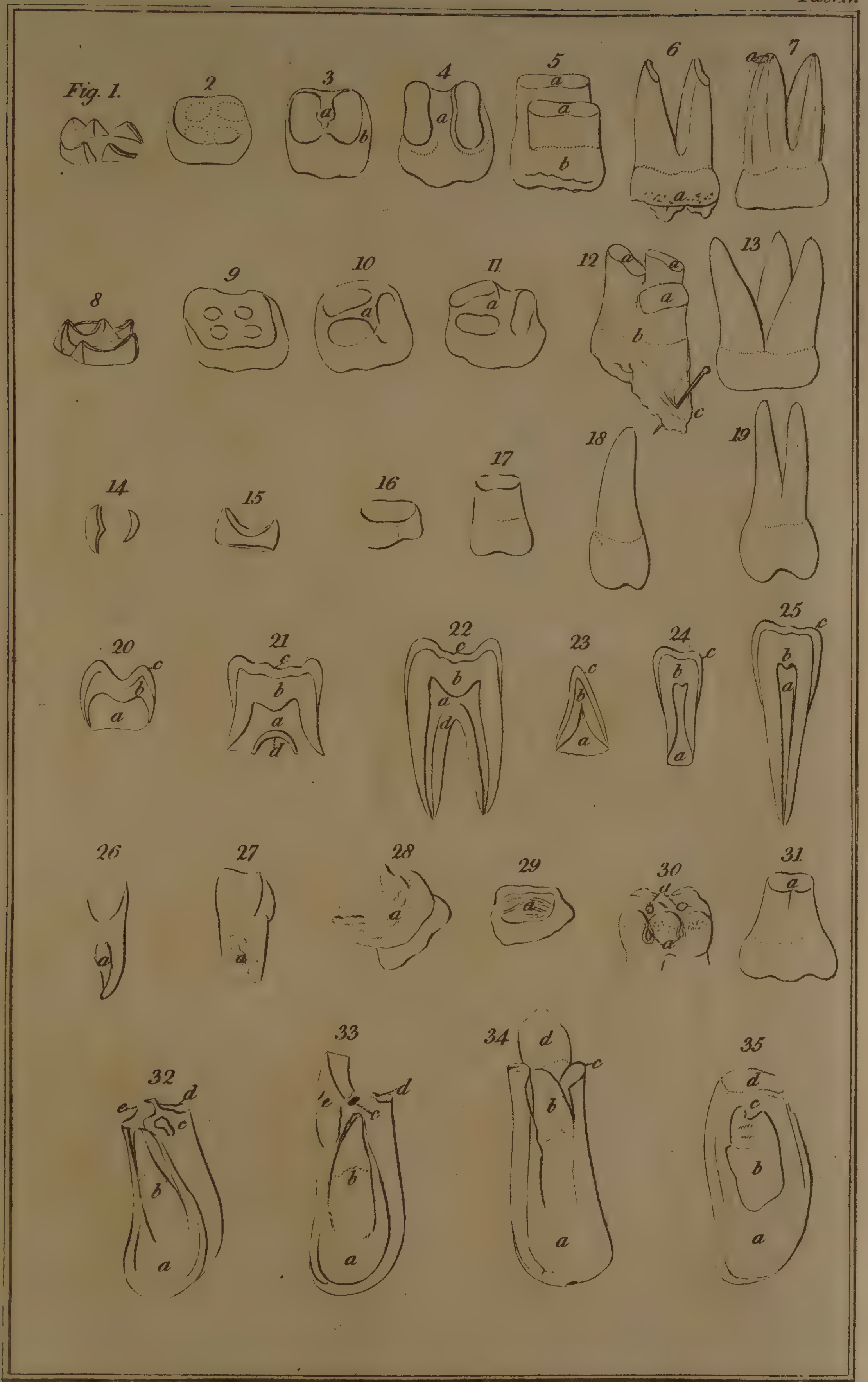
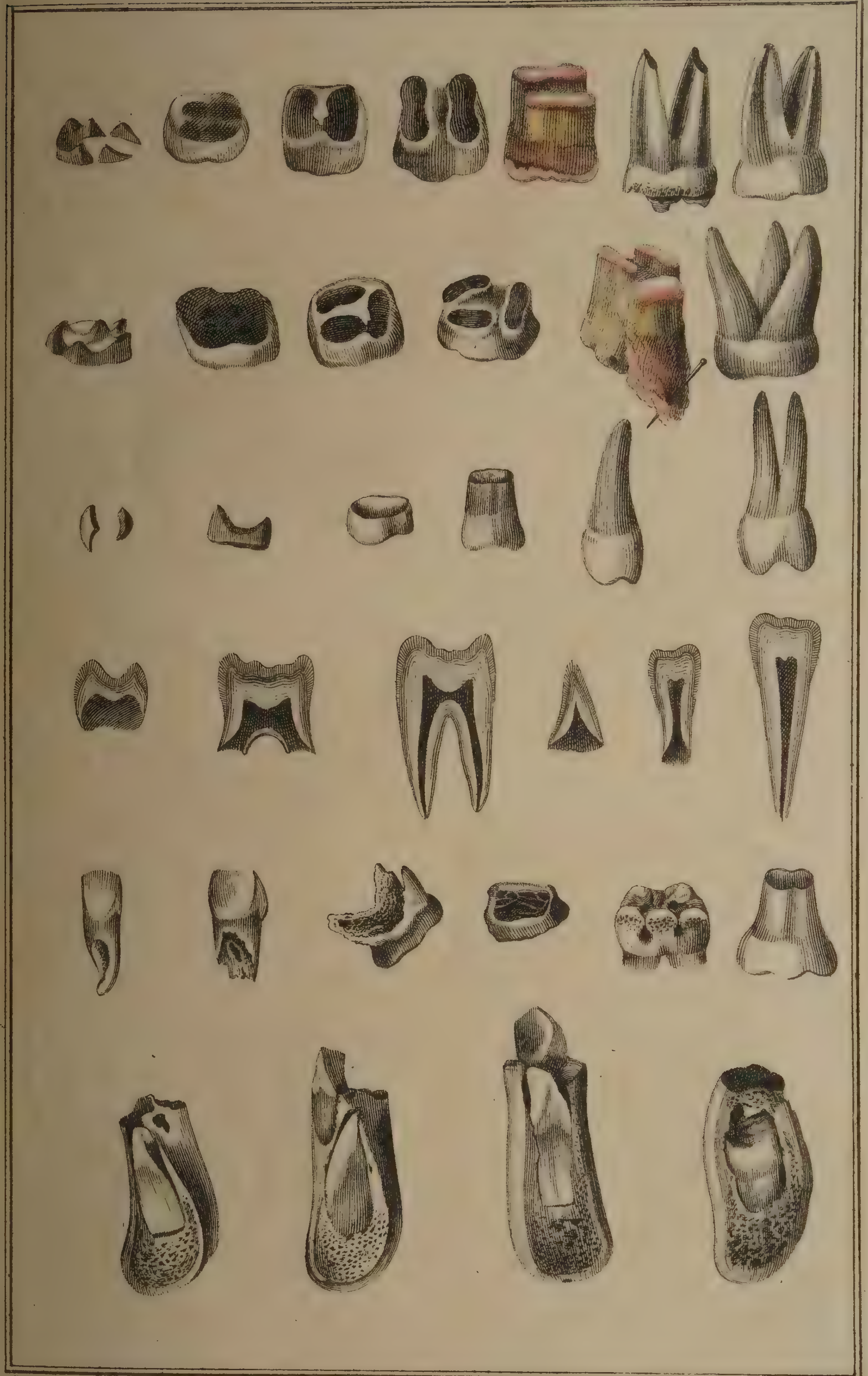
Tab. IV.





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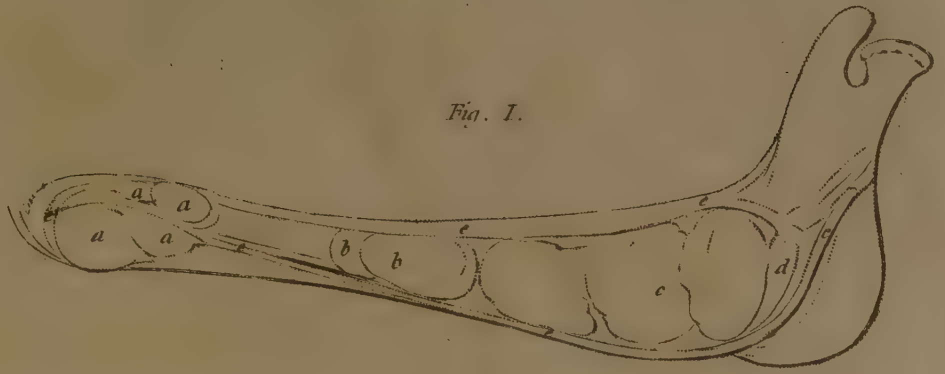
Aikton del.

Pub: as the Act directs by R. Blake 1798.

V

Fig. I.



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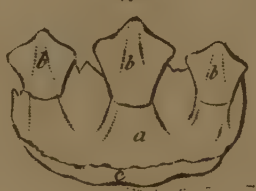

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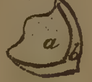

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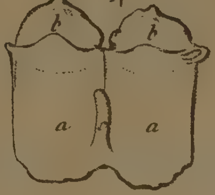

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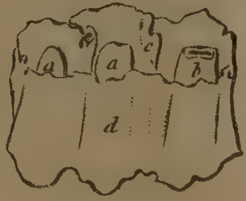

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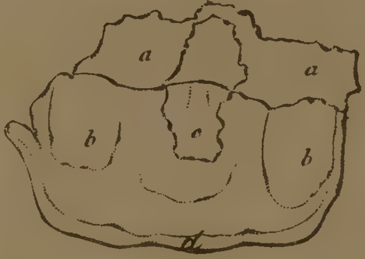

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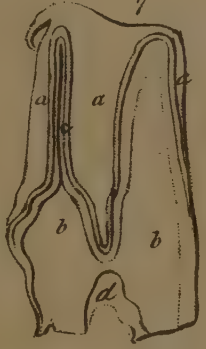

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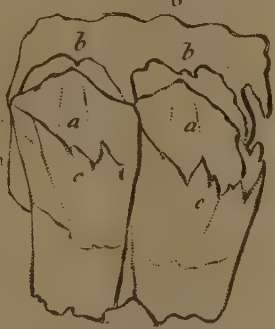

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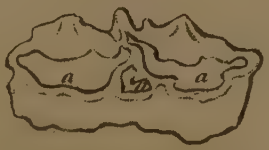

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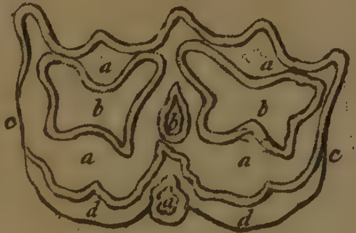

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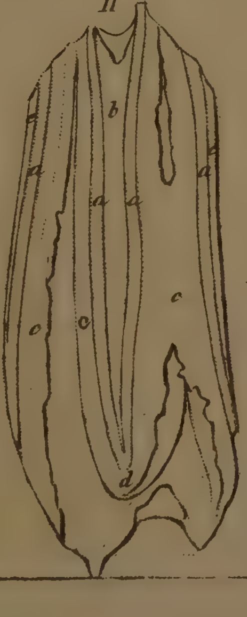

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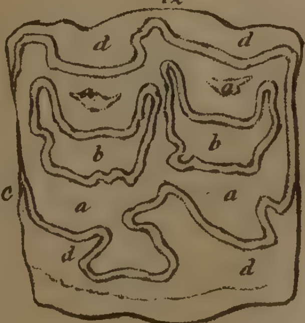

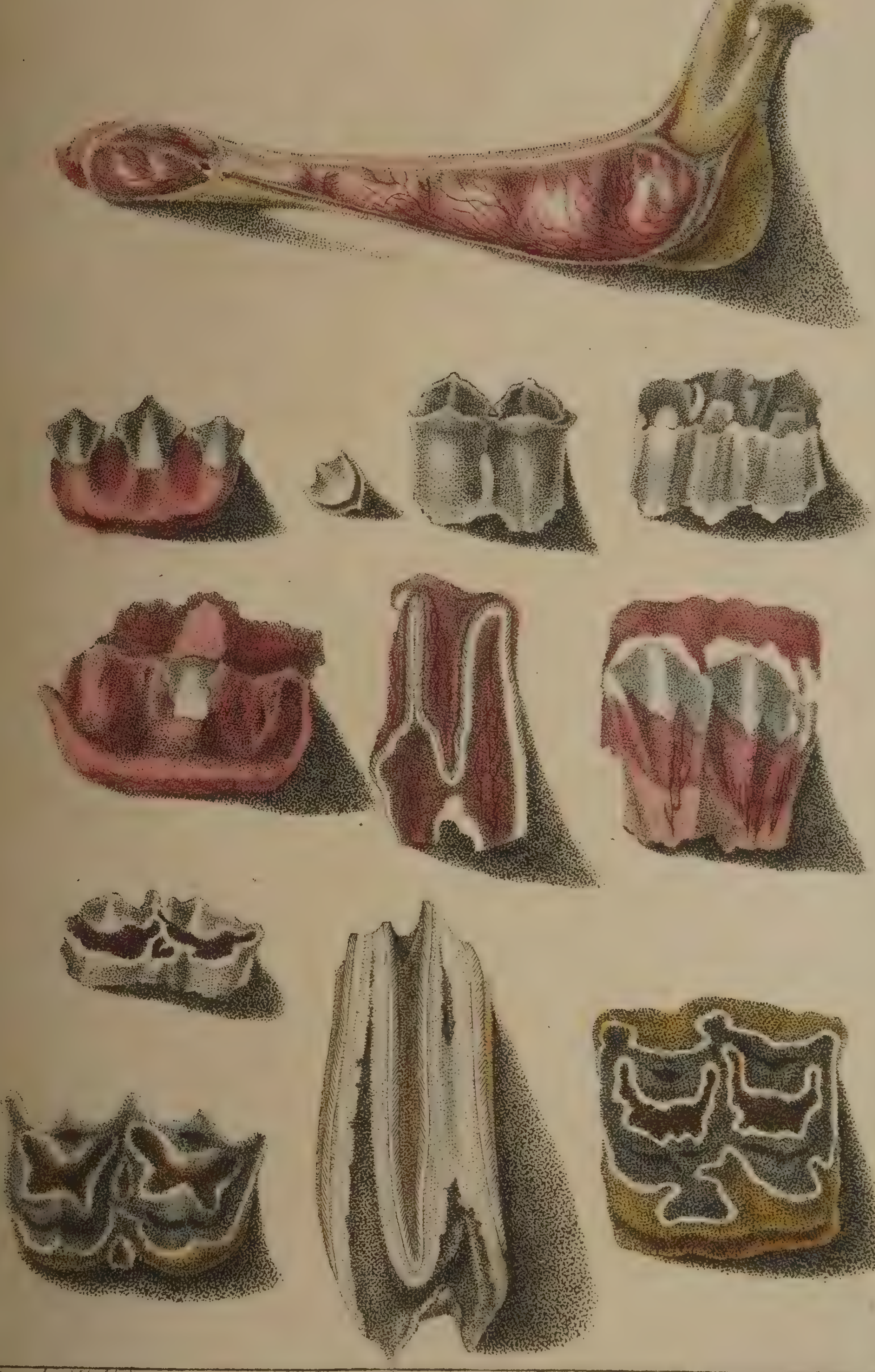

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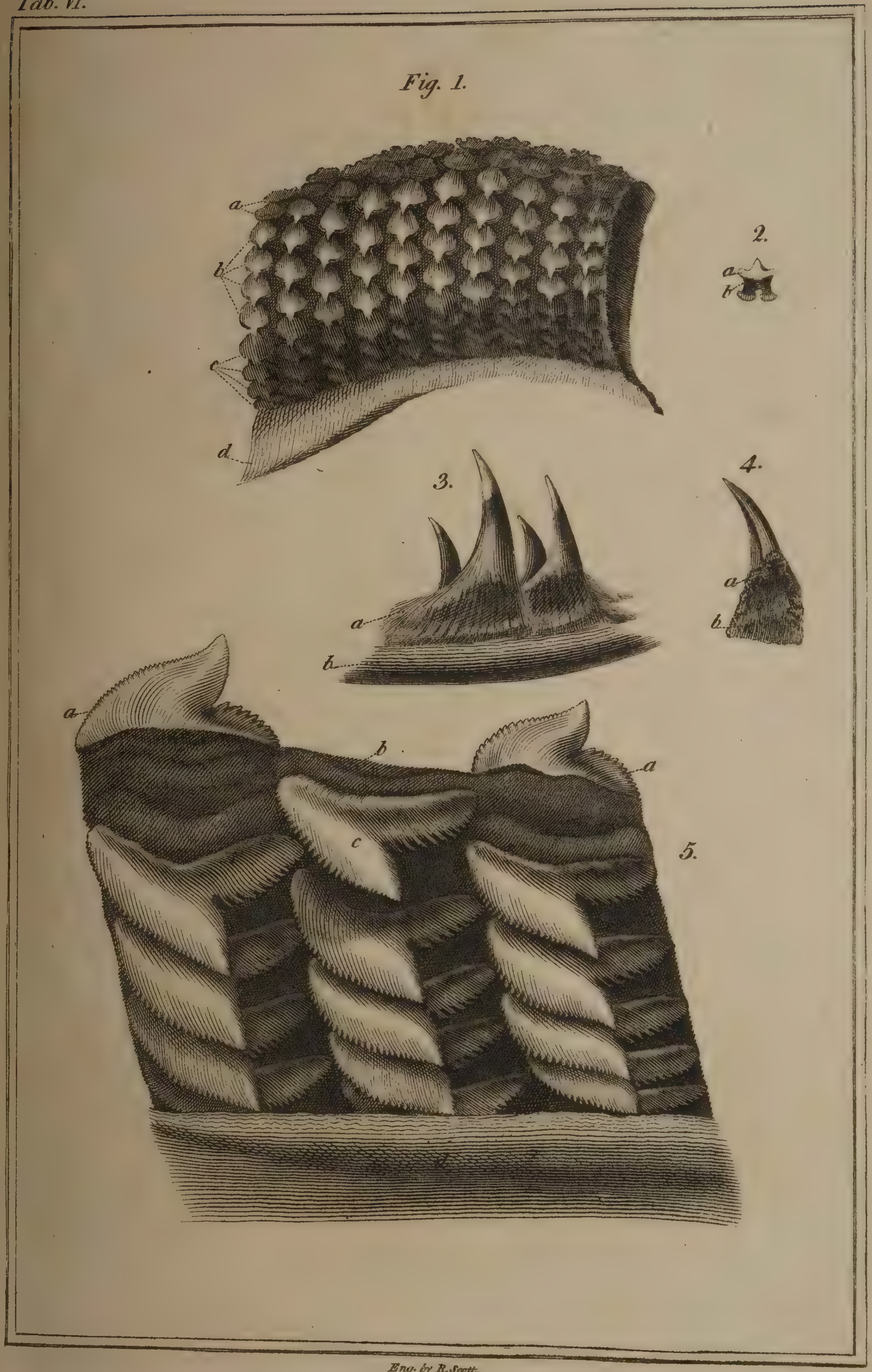
Tab. VI.



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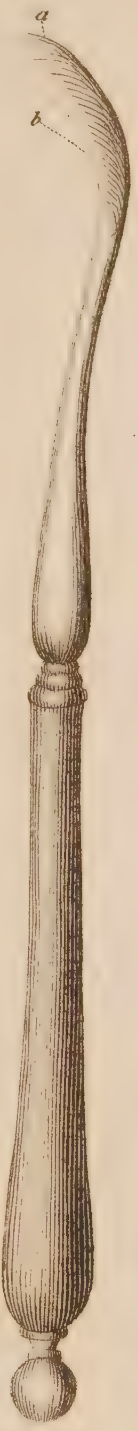
P. 7.

Fig. 1.



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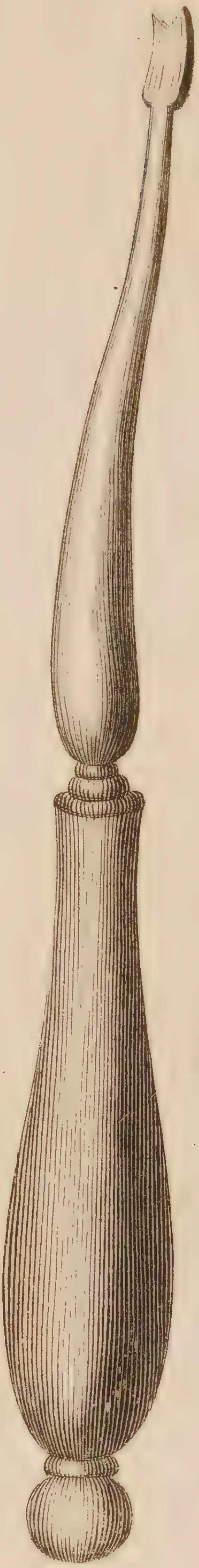

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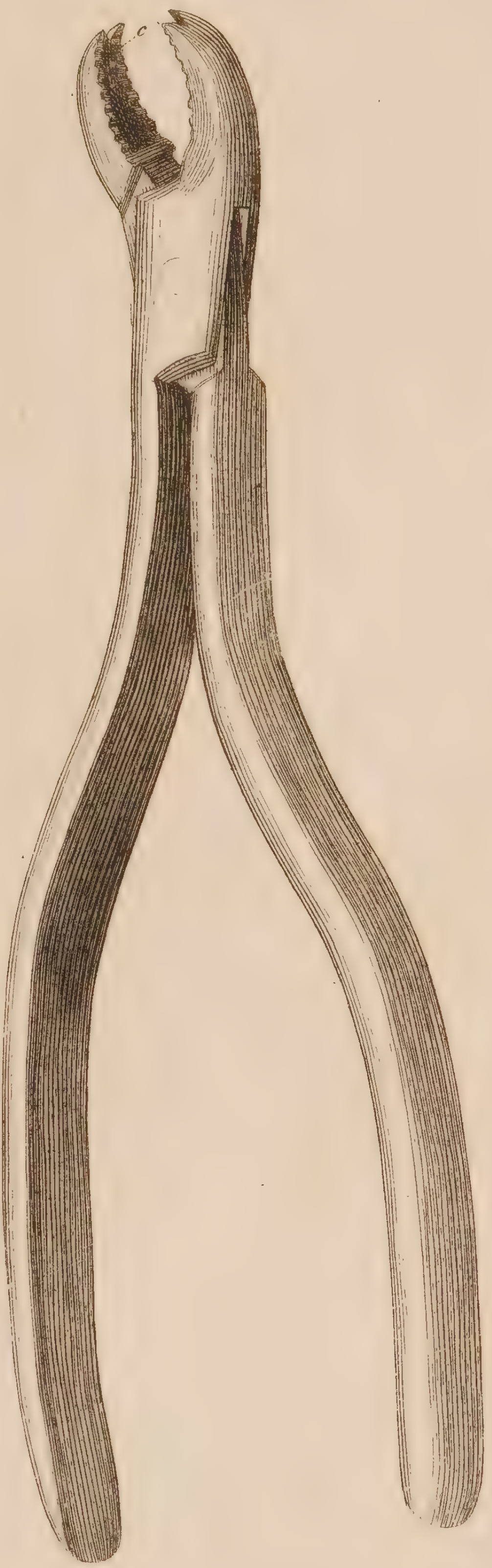

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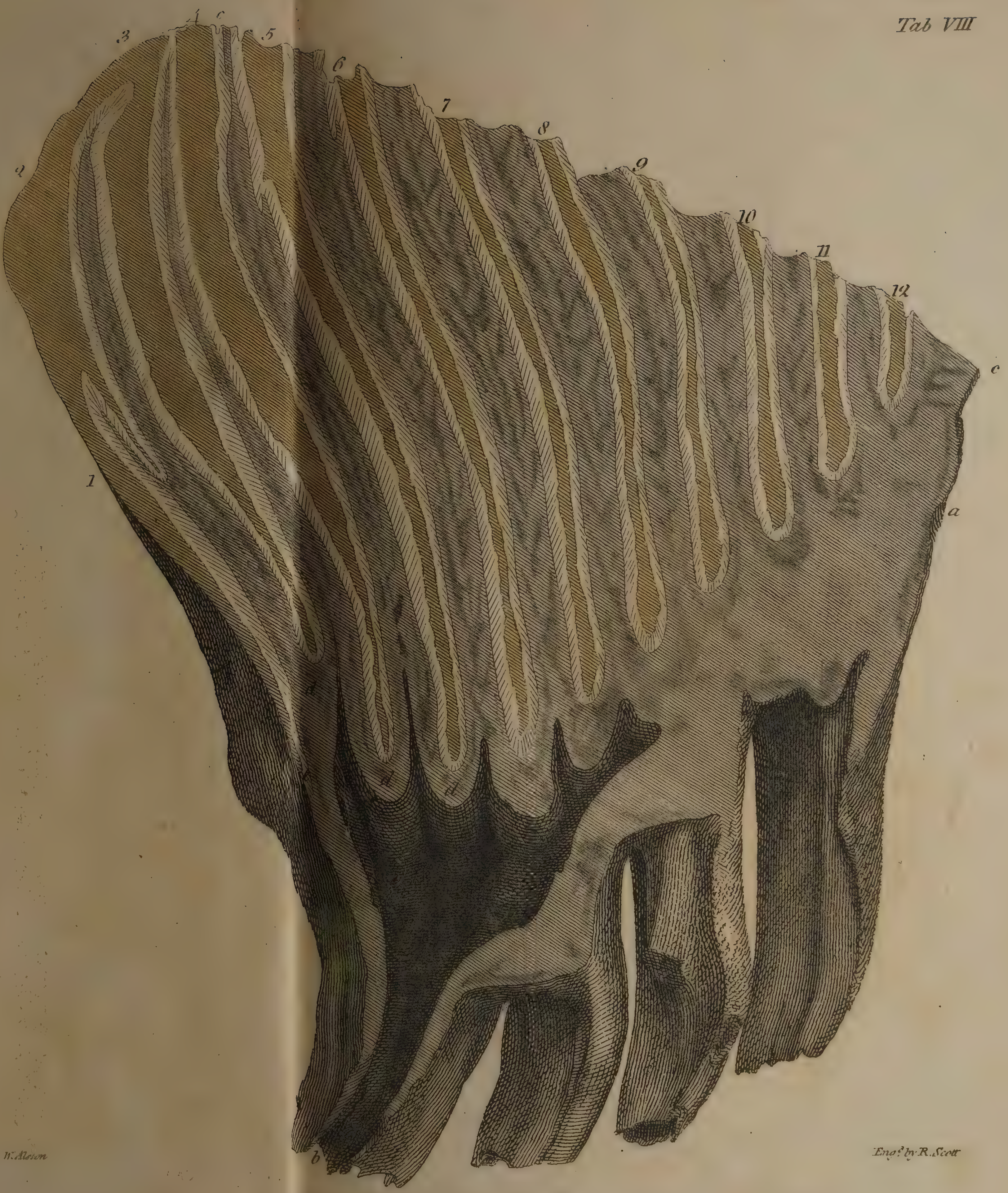
Tab VIII



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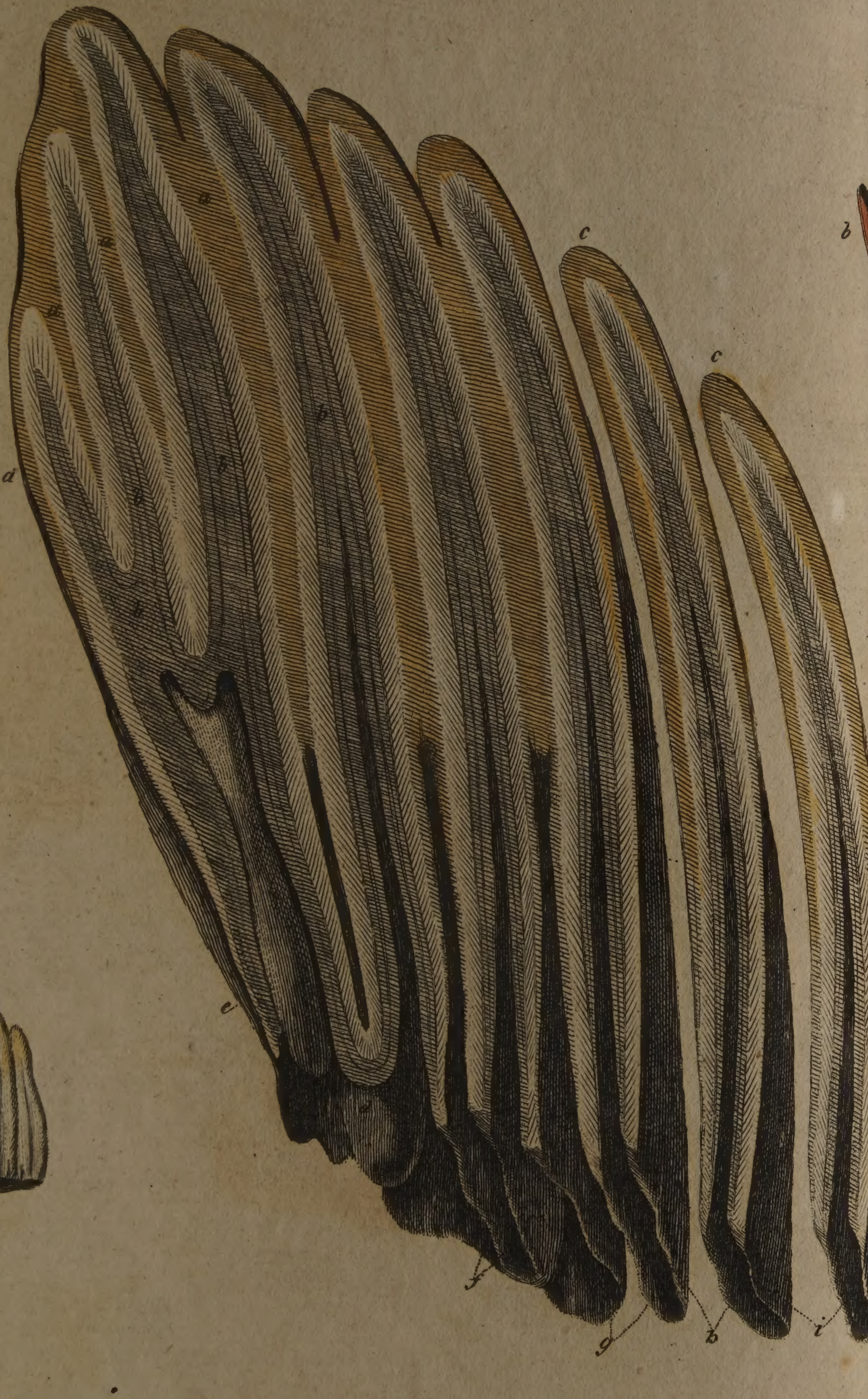
Tab. IX

Fig. 1



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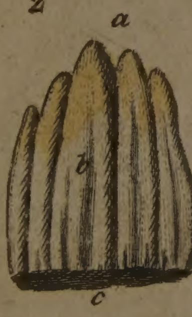

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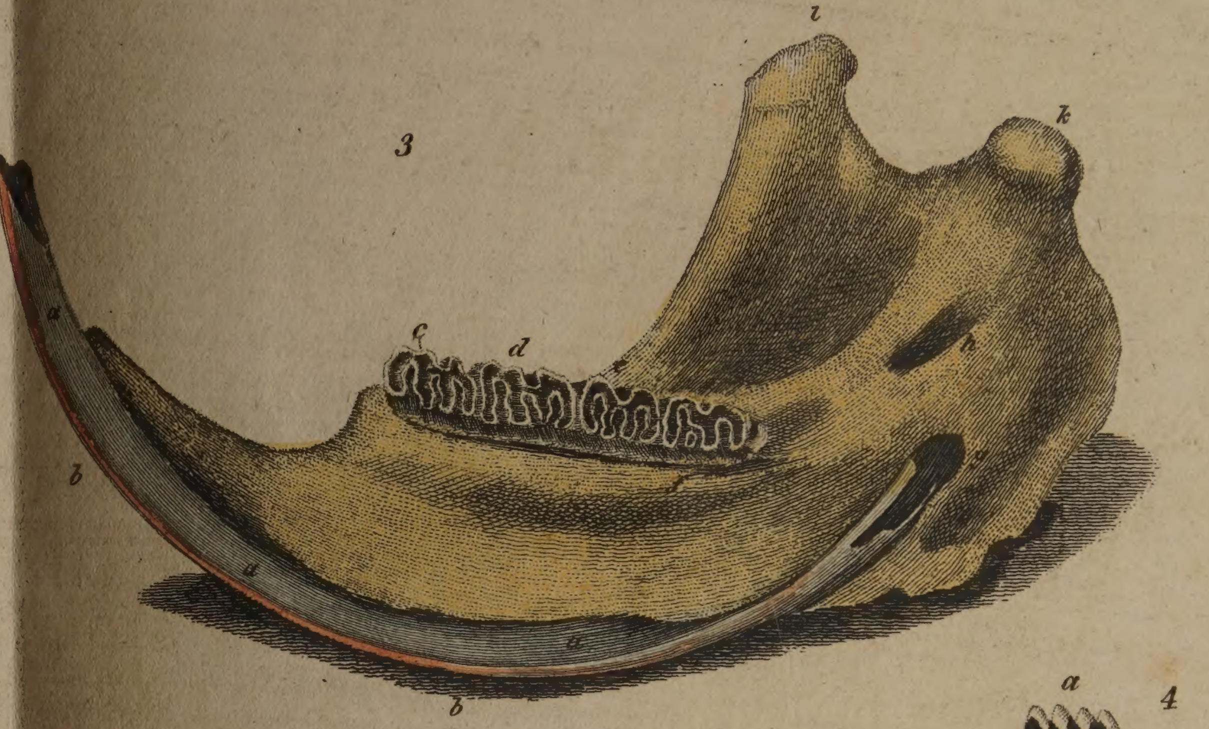

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J. Ford Del. et Sculp.ᵗ

Dublin Published by R. Blake M.D. 1801.